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BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

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VOLUME XLI
JANUARY TO DECEMBER, 1938
Numbers 1–6

INSTRUCTIONS TO BINDER

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.

The Lord of the Clover Field surveys his domain.

BULLETIN
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The Woodchuck: Lord of the Clover Field

"Groundhog Day" Finds the Animal Still Asleep in Its Underground Den Where It will Stay for Nearly a Month Longer

WALTER J. SCHOONMAKER
Assistant State Zoologist

FEBRUARY Second has been dedicated to the woodchuck and is known the country over as "Groundhog Day." On this date the woodchuck is a widely discussed animal; its publicity spreads throughout the land and stories and pictures of the grizzly-coated marmot appear in magazines and newspapers. As though it were Nature's official weather prophet, folk seek to learn whether or not the chuck will see its shadow, for it is an old popular belief that on this day the creature comes forth and, if it sees its shadow, retires for another six weeks and the weather will continue severe and wintry. If, however, it does not see its shadow, the woodchuck remains out and an early spring is assured. Although this notion has no real foundation, it is a pleasantly sentimental belief and may it long survive!

For those who do not know the animal it may be well to explain that the short-tailed, rugged-bodied woodchuck is a rodent or gnawing mammal which has broad, chisel-like front teeth in both the upper and lower jaw. When full grown it is usually more than twenty and less than twenty-five inches from the nose to the end of the tail bone and the vertebrae in the tail are five to six inches.

Generally the back is grizzly gray varied with chestnut, black and yellow; the scantily-haired belly and the legs are quite red or rufescent and the tail and feet are usually dark brown or nearly black. This typical color, however, is subject to a great deal of variation and may range from white to black. The melanistic color phase is quite common, but the albino individual with pink eyes is rare because the mother may kill and eat the striking and off-colored offspring soon after birth. Also the white specimen is most conspicuous and therefore readily observed by enemies. When once sighted by hunters, who are extremely desirous of securing unusual trophies, the albino groundhog has little chance to escape. If the hunter fails to kill the chuck at first, he may find his quarry day after day or even year after year at the same den or in the same locality.

The weight of the woodchuck varies somewhat with size, age and season. In spring adults weigh usually five to seven pounds, while in the fall they are nine to eleven and rarely thirteen pounds. Immature individuals balance at four to five pounds in spring and six to seven and one-half pounds in autumn.

An abnormal growth in the front teeth of the woodchuck is rather common. The incisors normally grow rapidly and continuously and are kept in proper condition by grinding against each other. When these fail to meet, both upper and lower teeth may make a complete circle and pierce the roof of the mouth. Although

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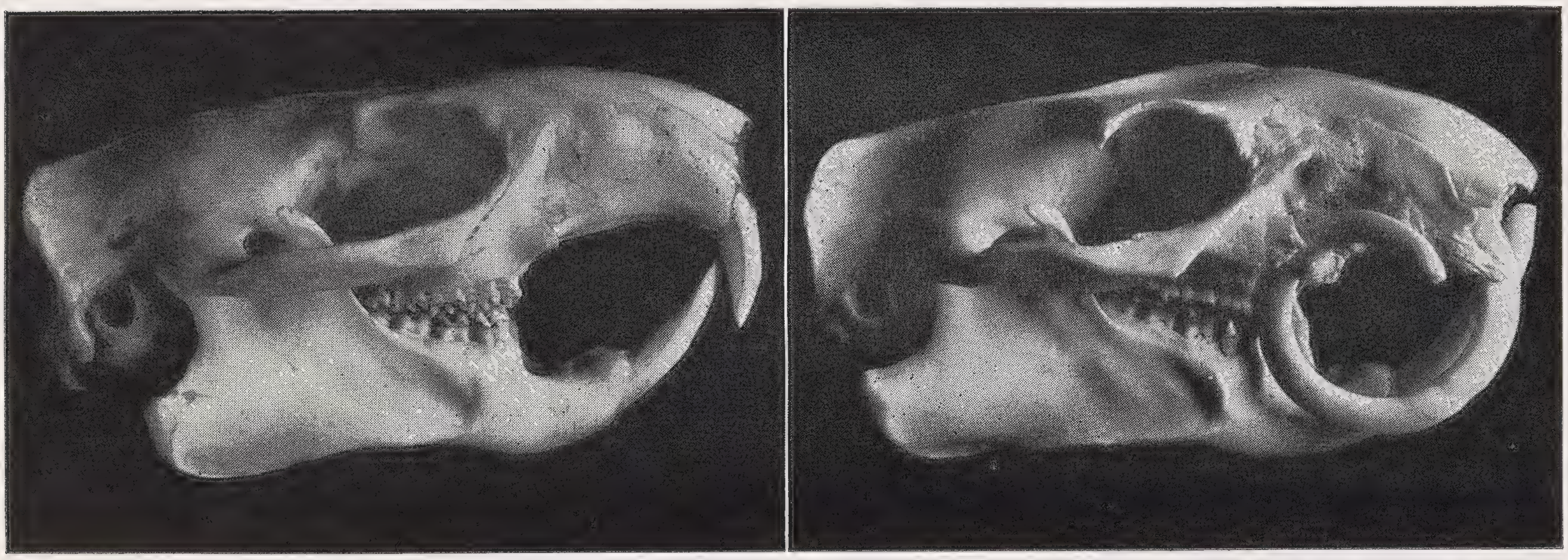


These two woodchuck skulls illustrate the normal (left) and the abnormal (right) growth of the incisors. They grow rapidly and are kept in proper condition by grinding against each other. When they fail to meet, both upper and lower may make a complete circle.

this condition may be painful it is not always fatal, but the unfortunate victim may have considerable difficulty in obtaining food.

The age which the animal may attain in the wild can only be estimated but it seems that the length of life is approximately ten years. It is definite, however, that neither male nor female becomes sexually mature until it has reached the age of nearly twenty-four months, and therefore the woodchuck does not breed until that age has been attained.

When the groundhog is supposed to be announcing future weather conditions, it is actually hibernating in an underground den, far beyond the reach of the frost, and it does not matter to this sunshine-loving rodent whether the day is clear or blizzards rage.

In fact, it is nearly a month after Groundhog Day has passed and the chuck is forgotten by most people, that the creature really awakens, unaware that only a short time ago it was quite an important character. With this awakening begins its active life.

The date of emergence is regulated to some extent by the locality and the weather conditions. In New York State the first appearance is usually about March 1, while farther south the gray-backed sleeper may come forth earlier.

While the woodchuck had been sleeping, escaping the rigors of winter yet missing its frosty grandeur, it drew from the supply of fat which had been stored in a thick layer just under its skin and in its body cavity. A more extensive drain on this supply is experienced immediately after its emergence, however, because its food, which consists mainly of green plant life, is very scarce during late winter and early spring.

It is the males which awaken first and emerge to seek mates. The urge to perpetuate their race sends them on journeys, often very long journeys, over snow-covered fields, through wet and soggy lowlands and through muddy ravines, until they find their mates. The blustering winds, deep snows and torrential rains that so often come at that season are no deterrents to these wanderings, for there is behind them an ancient determination and absolute certainty of purpose.

The mating period extends from March to June and is governed more or less by the locality. It may be a few days or it may be as long as several weeks before a male fulfills the purpose of its journey, but when a mate is found the two animals live together, for a time at least, in the den of the female.

The period of gestation is about twenty-eight days. As the time draws near when the pregnant female will give birth to her young, her interest in her mate ceases and she drives him forth to a den of his own or discourages his attention so that he willingly leaves. If her mate is big, strong and very persistent, however, and refuses to be driven out or discouraged, the female steals away, cleans out an abandoned den, or digs one anew, and prepares her brood nest where she brings forth her young under the conditions she so desires.

Generally the woodchuck's back is grizzly gray mixed with chestnut, black and yellow. Its belly is quite red and the tail and the feet are dark brown or black. However, this typical color is subject to much variation, and very dark or even black individuals are rather common.

Albino woodchucks are occasionally encountered, but they are a conspicuous mark for the hunter's gun and they seldom live to an adult age. Usually they do not even leave the home nest, for the mother is apt to kill and eat the more striking and off-colored of her little family.

Mother woodchucks prefer to rear their young in a den on an open, rolling hillside where the sun may shine unobscured and where the land is well drained and dry. Here there is likely to be an abundance of fresh green food at the very doorstep and because there is no cover the approach of an enemy is almost certain to be observed.

The brood chamber, which is located several feet underground, is about fourteen inches high and sixteen inches wide; in this is constructed the brood nest of dried grass, with the finest material in the center.

Although the eggs are formed before the female goes into hibernation, they do not become fertile until the following spring after a successful union of adults. Development then begins and after twenty-eight days the litter is produced.

When first born, during the breeding period that extends from early April to mid-May, the infant is blind, naked and helpless; the skin is wrinkled and the babe measures slightly less than four inches from the nose to the tip of its tail. A litter may vary in numbers from two to five. Two, however, is unusual and three or four youngsters are most frequently observed with the mother.

When approximately six weeks old the babes are about one-fourth as long as their parent and weigh only about half a pound. They are now fully furred, their eyes are open and they are ready and eager to go forth into the bright sunlight. To the mouth of the den they come to stop and look with eyes that are soft, brown and full of wonder, upon a world that is new and amazing. They may see in the distance an apple orchard in full bloom or silent meadows graced with yellow, nodding dog-toothed violets or the shadbush, lovely with flowers. If it is late in the season, myriads of buttercups mingled with clover blossoms, Indian paint brushes and daisies will be waving in the breeze, and nearby, in their very dooryard, indeed, they are almost certain to find green clover, alfalfa and grasses. These delicacies shall be their favorite foods henceforth, although they may also eat dandelions, sunflower, hawkweed and other succulent plants.

For days after their first appearance the young do not wander far from the entrance to their den and three or four feet is usually the extreme distance which they dare to venture. The process of weaning begins immediately and the mother accomplishes a great deal along these lines by feeding fifteen or twenty feet from the home. The babes, not daring to follow, are forced then to eat the solid food near the mouth of their burrow.

The chucklings feed and play near their home with no concern, for at this early age they know nothing of fear or of enemies. However, if full growth is to be attained they must be taught that there are real dangers from which they must learn to escape. And one of the very first things which the wise woodchuck mother teaches her offspring is to seek the den quickly. To do this she often feeds two or three feet from the burrow and encourages the babes to follow. Then, though no enemy is near, she suddenly dashes into the den and the young scamper in also. Quickly they reappear and the mother, feigning caution, looks about carefully, sits up, scans the country and tests the breezes. She then begins to feed and the performance is repeated. Soon the young become sufficiently agile to reach the den before the mother and when they attain this stage her purpose has been accomplished.

As the young grow older they of course become more wary and the teachings of the mother were not in vain, for those that live long are ever careful to stop, look and listen before emerging from their den. The more cautious individuals frequently sit up while feeding and search the countryside for possible foes.

The den that was their birthplace is soon crowded, for the youngsters grow rather rapidly. To relieve this condition the mother separates the family and usually locates each member in a different burrow, which has been prepared in advance for this purpose.

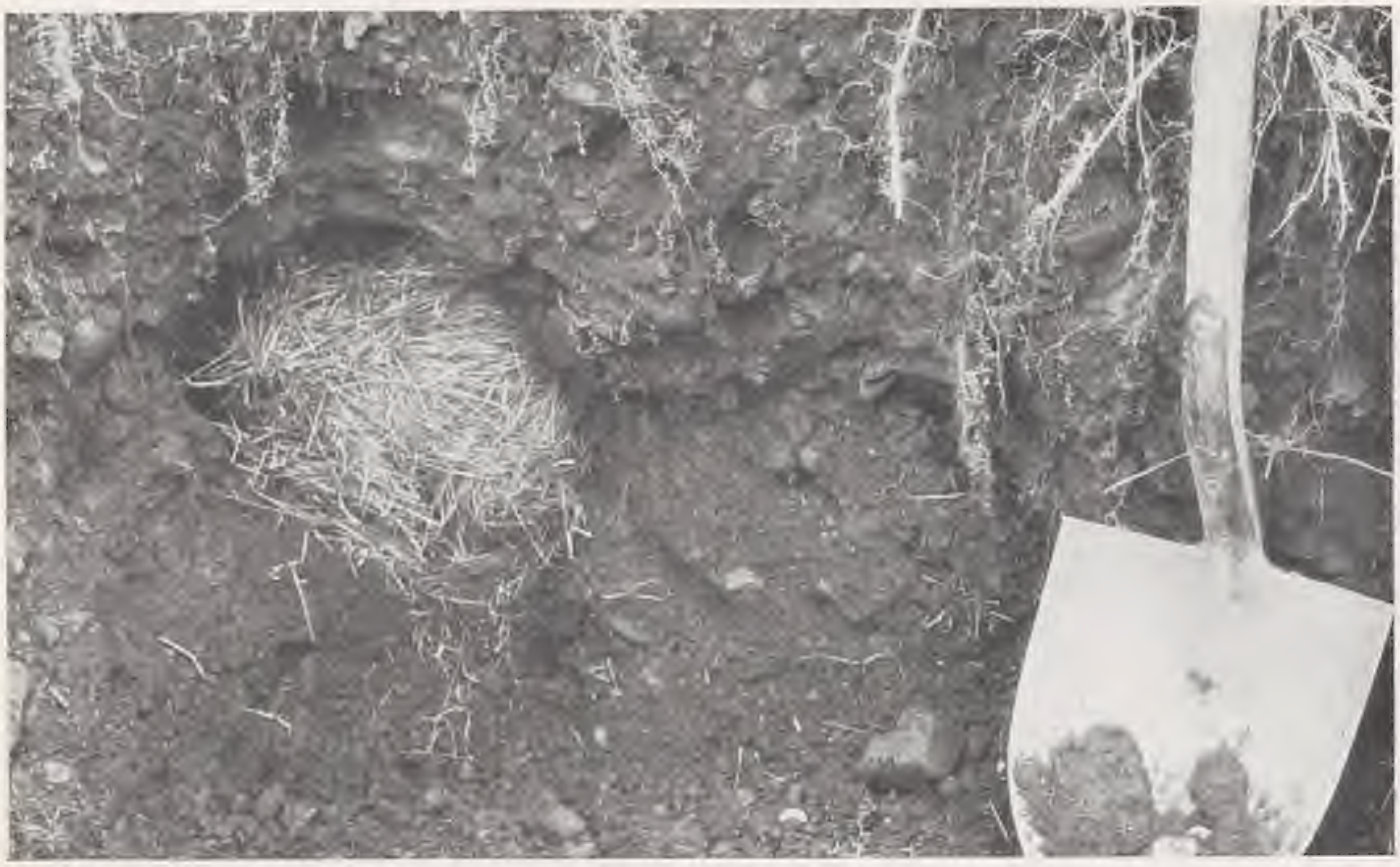
Although the female lives alone after this change, she visits with her young several times each day.

This separation may begin as early as the middle of June, although the exact time is determined by the age and size of the offspring. Of course, the procedure may be considerably altered if the litter is small, or if the family is reduced by death.

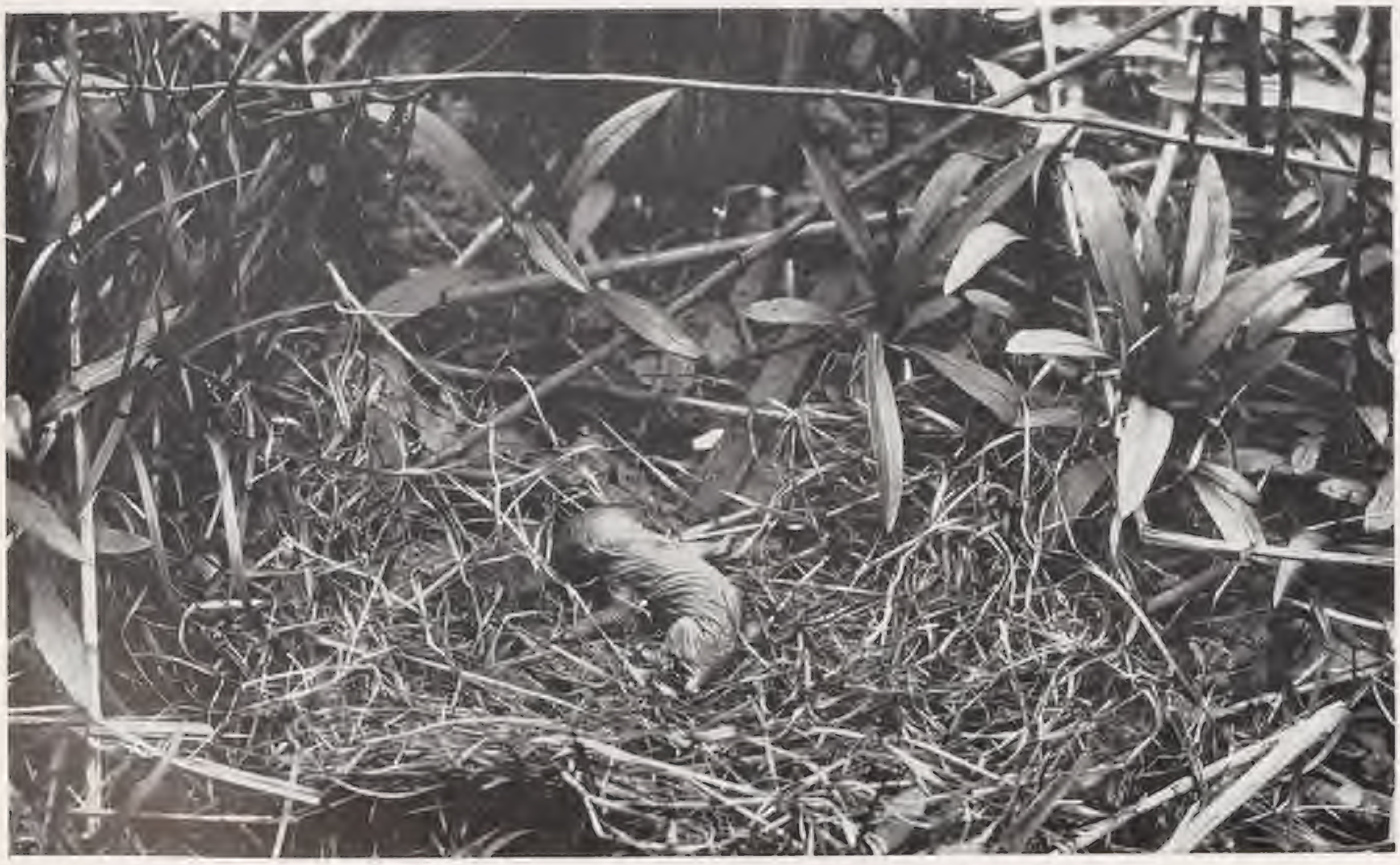
A two-fold purpose is served by this change. Aside from relieving the crowded conditions in the home, the young are forced to care and pro-

In the very early spring, before the weather has settled, the males awaken first and travel far and wide in search of a female with which to mate. When a female is at last found, the pair live together for a time at least in the den that the female had occupied during the winter.

But when the female is about to give birth to her young, her interest in her mate ceases and she attempts to drive him away. If he refuses to be driven out or discouraged, the female herself steals away to an old den or digs a new one in which she prepares a brood nest.



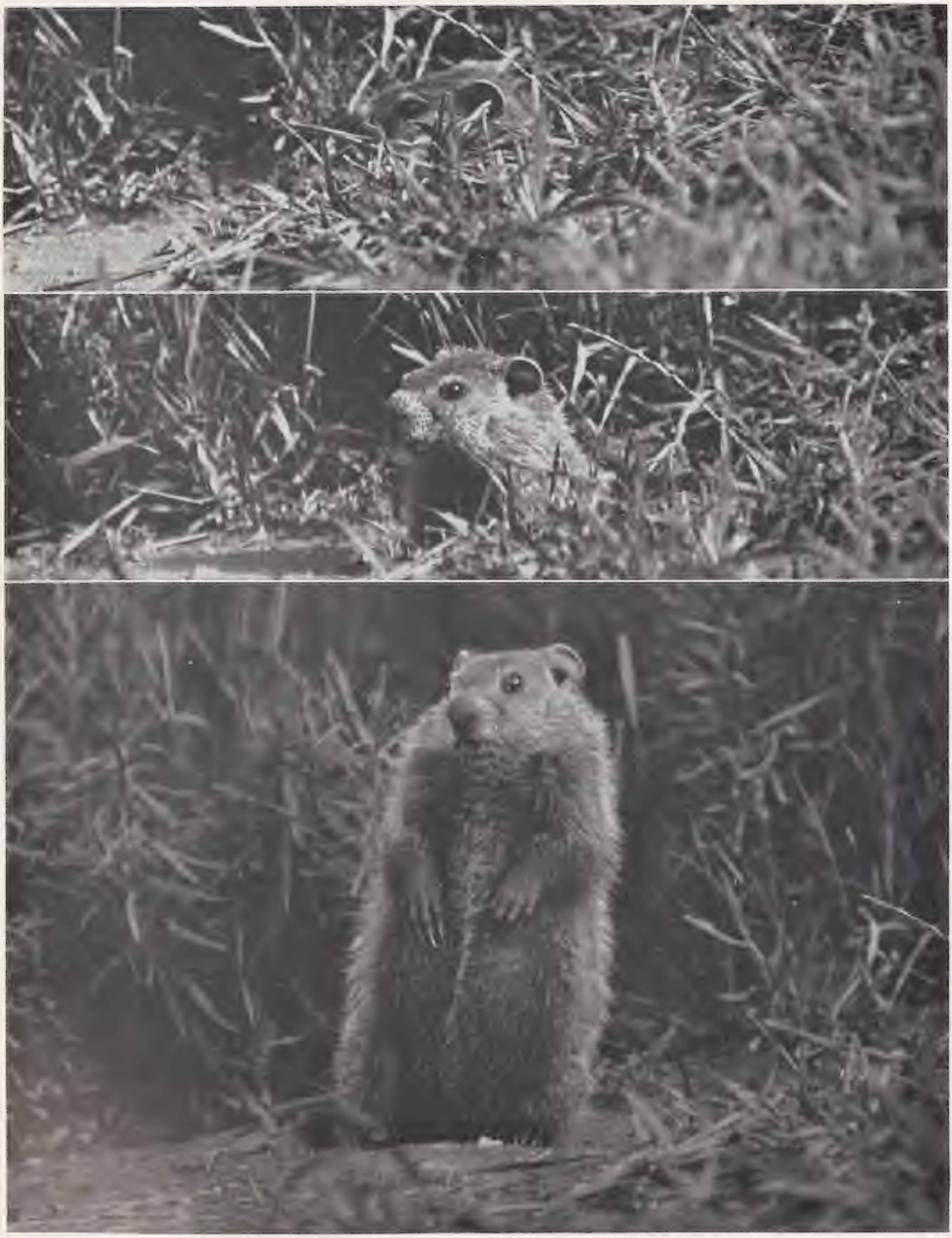
The brood chamber is located several feet underground. It is about 14 inches high and 16 inches wide, and in it is the brood nest composed of dried grass. This nursery is similar in all respects to the nest of the adults and both may on occasion be used for the same purpose.



The newly born woodchuck infant is blind and hairless. Its pink skin is wrinkled and it measures slightly less than four inches in length. A litter may vary from two to five, but two are unusual and three or four youngsters are most frequently seen in the mother's company.

When they are about six weeks old, the babes—now fully furred—come out of the home den for the first time. If their mother has chosen their home wisely, they will look out upon a world that provides an abundance of the foods they especially like, and at their very dooryard.

The mother often feeds several feet from the burrow and encourages the babies to do the same. Then, though no enemy is near, she suddenly dashes into the den and the youngsters do likewise. By such games they learn the important lesson of quickly seeking shelter from danger.



When emerging from its den the wary woodchuck, showing only the top of its head, scans the field and tests the breeze. Then, if all appears well, it comes out a little further and again looks carefully for possible danger. Then it sits erect, tests the wind, and goes forth to eat.

vide for themselves and are prepared, therefore, to lead a successful, independent existence when the parent is no longer interested in their welfare.

Later in the summer the young may abandon the den that was a haven of security and desert the fields of their birth to go on a great venture into territory that is new and to them unknown. It seems that the great plan of Nature tends to prevent in-breeding, and evidently some urge causes the youngsters to wander afar and to find or excavate burrows of their own in which they alone shall probably spend the winter. This period of wandering may begin in July and extend into September and it is indeed a most perilous time, for many of the fields are then cut and the woodchucks are easily seen and killed by hunters, dogs and red foxes. Many even meet a tragic end before they have traveled beyond the range of their mother's vision.

The woodchuck is a child of the sun. Seldom does it appear before sunrise and usually it retires before dusk, although on rare occasions it may be found abroad at night. It readily climbs trees and it swims with ease, although it is not as agile as its long-tailed cousin, the squirrel, nor as aquatic as its more distant relative, the beaver. It is an accomplished digger, however, and finds a home and safety in the bosom of Mother Earth. Its burrow measures about seven inches in diameter and may be from three to twenty-four feet or more in length. Two entrances to the den are usual. One is prominent, with a mound of earth before it, while the second, the air hole or lookout, is often quite concealed and no loose earth is near it. The nest is located in a chamber in the burrow and is composed of dry grass—similar in all respects to the nursery. In fact, the same nest may be used for both purposes. An excrement chamber is

Trophy of the gun—a defenceless and harmless wild creature killed for no purpose other than to provide a living target for a hunter. What the woodchuck's economic role may be, we do not fully know, but the wild world would be far less interesting if it were exterminated.

also located in the underground tunnel, and nowhere else, inside or outside of this, will waste matter be found.

A number of dens may be located in a field and a network of well defined trails, which vary in width from four to six inches, usually connect these.

Fat and well fed, the monarch of the clover field drowses lazily at the mouth of its den in the warm rays of the late summer sun. Golden autumn approaches; grasses wither and turn brown, and leaves of yellow, red and gold blaze in the sunlight. It is at this time that both young and old of the groundhog seek their beds of dry grasses and enter into the long winter sleep known as hibernation.

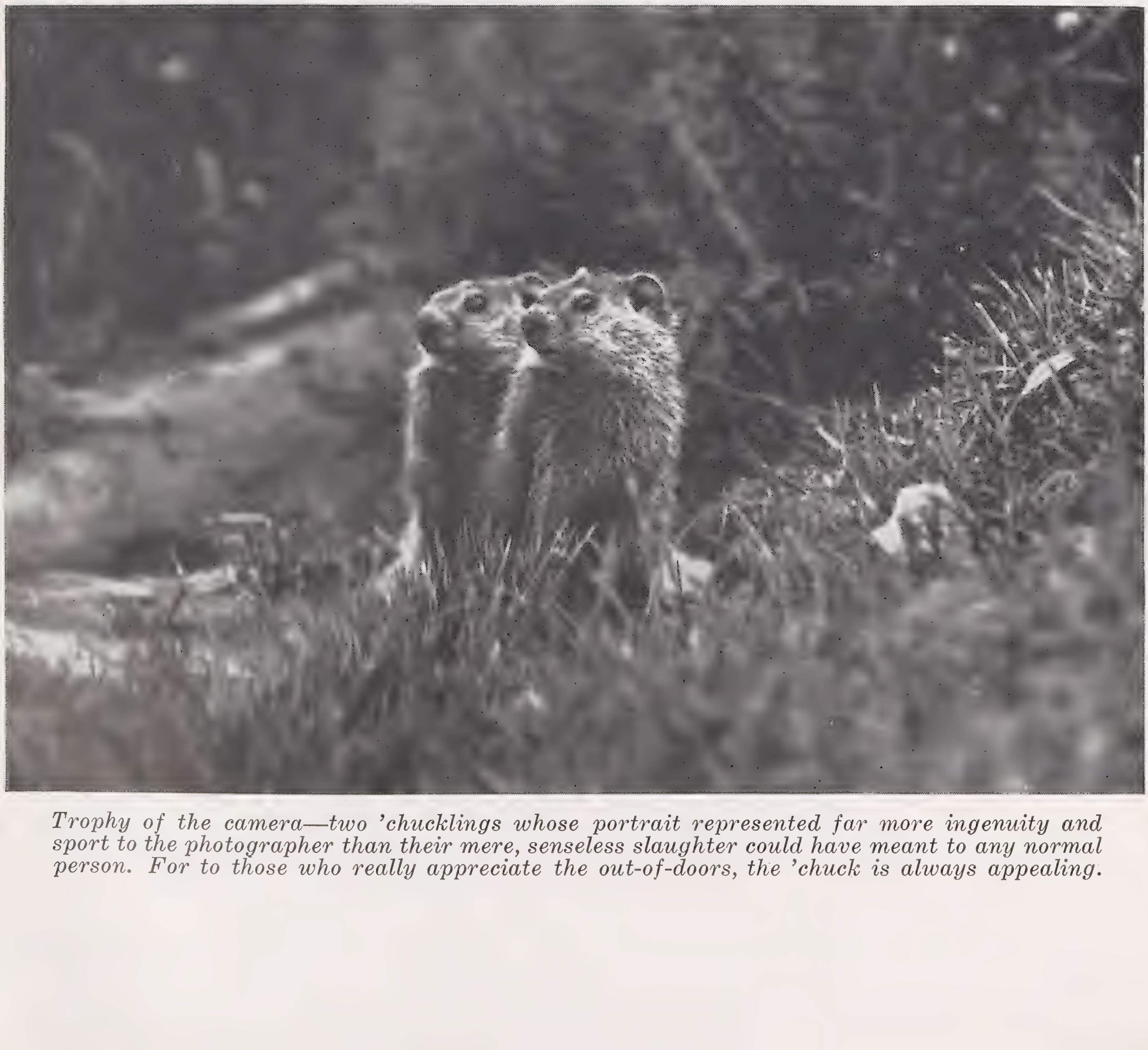
Snow flitters down and covers the fields and meadows that had been their home and feeding ground and now the dens may be the only evidence of the creatures' presence.

The exact time at which these rugged winter sleepers close their eyes upon the world varies according to locality. In the north it is earlier than in the south and may extend from late September to early November.

* * *

The woodchuck digs holes; it piles gravel and dirt in mounds that may dull the knives of farm machines; it feeds upon clover, alfalfa and other crops. That is the usual extent of its damage and that is why it is often condemned. But as all life has its assured and important place in the great scheme of Nature, the woodchuck cannot on any such grounds be denied a right to live. When we see Nature's plan more fully we may find that it plays a greater part, even a greater economic role, than we at this time realize.

No matter; there are values that can hardly be computed in dollars and cents and to those who appreciate the out-of-doors and the presence of the many wild folk which make the world so much more interesting, the familiar "chuck" needs no apology.



Trophy of the camera—two 'chucklings whose portrait represented far more ingenuity and sport to the photographer than their mere, senseless slaughter could have meant to any normal person. For to those who really appreciate the out-of-doors, the 'chuck is always appealing.

"Dr. Townsend of the Aquarium"

His Retirement at the End of Thirty-five Years Is a Prelude to Intensive Studies of Whales and Tortoises

THE soft glow of gas lights still struggled to illuminate the exhibition tanks of the New York Aquarium when Charles Haskins Townsend came up from Washington to take charge of the young institution for the still younger New York Zoological Society.

Change was in the air; it was the year 1902 and the city's first subway was under construction but not yet completed; automobiles were coming in, but horses were still not going out; the Wright brothers were at work but Kitty Hawk was still in the future. The Aquarium was a young institution in an old, old building, and it was destined to change with the times, as much as its ancient shell would permit. It was up to "Townsend of the Aquarium"—not yet Dr. Townsend—to change it as he could. The New York Zoological Society was already setting an example up in Bronx Park where the Zoological Park was rising out of a jungle of rocks, forest trees, swampland and carpenters' debris.

The new Director came from a post as Chief of the Division of Statistics of the United States Bureau of Fisheries. His work for the Government had taken him to Europe and he had just returned from a tour of the great European aquariums. He knew what others were doing and what needed to be done in New York.

Thirty-five years have passed since he took hold, and they have seen New York and the world change to what it is today. With them the Aquarium has changed and it is a good time now to consider some of the changes, the difficulties and obstacles that held them up, the genius of the directing spirit, and the triumphs and heartbreaks and perseverance of the Director himself.

The Aquarium improvements are all recorded in the annual reports of the last three and a half decades, but no one not closely connected with the institution could gather from the sometimes laconic passages on those pages the human struggles that have gone into making the Aquarium the mecca of some two and a half million visitors annually.

Each exhibition aquarium was originally a white-tiled tank, giving the place an effect not dissimilar to that of an average middle class bathroom that had badly overgrown. Aside from the unpleasant atmosphere so created, the fishes, many of which tend to match the tone of their surroundings, if not the pattern, uniformly took on their lightest color phase, resulting in an exhibit of well-bleached specimens. The largest glass fronted aquarium then measured four feet deep by six feet long by four feet wide. Now the largest measures six feet deep by twenty-four feet long by eleven feet wide. The bathroom style of tiling is gone and naturalistic backgrounds are employed wherever suitable. Not only is the visitor benefited, but the specimens are not harried by unaccustomed, glaring white surfaces. They are provided with nooks and crannies suitable to the needs of their particular kinds. This has enhanced both the educational and aesthetic value of the exhibits and insures longer-lived specimens.

Less evident to the casual visitor, but certainly more important to the needs of the exhibits, was a radical change in the water supply of the marine section. Up to the time of Director Townsend, water was merely pumped from the nearby harbor into the tanks and then allowed to flow back. Now it so happens that New York harbor does not contain sea water. It is brackish water at best, being continually diluted by the great influx of fresh water from the Hudson River. Many marine species are quite unable to survive for long in water diluted to the extent of that in New York harbor. Worse than that, even, is the extreme inconstancy of its

CHARLES HASKINS TOWNSEND
Director of the New York Aquarium • November 2, 1902—November 1, 1937

character, since it has two major fluctuations a day in the normal tides. At flood tide it is most nearly like sea water, when the tides rush in and retard the ever-seaward flow of the river water. At ebb tide it is most nearly fresh, when the river water runs out rapidly, unimpeded—or, rather, is sucked along by the outgoing tide. Superimposed on this are other fluctuations, including variations in the river flow, wind direction and velocity as well as seasonal tidal changes.

As if this were not bad enough, New York harbor has long been plagued by sewage and the frequently very toxic factory wastes. If this were an item thirty-five years ago, think what it would mean today to try to run an aquarium with the harbor as the sole source of "sea water."

After much argument and struggle Dr. Townsend remedied this impossible condition by the construction of a 100,000-gallon reservoir for sea water. Here pure ocean water could be stored, filtered and handled according to the needs of the institution and independent of the vagaries of weather or the manufacture of silk cloth in Paterson, New Jersey. This reservoir, relined in 1928, is still in service.

Next in importance to these two items that held Dr. Townsend's early attention came the matter of admittance of daylight to the exhibition tanks. Small skylights, as originally provided, gave insufficient illumination. These were enlarged, but structural considerations concerning the needs of the roof prevented the fullest possible admittance of light. Finally no less than fifty-six new skylights were cut through in addition to the original enlarged openings.

A story goes with each successive improvement: the installation of a ventilating system, the introduction of electric light to replace gas light, the changing of, actually, miles of piping—a huge plumbing job in itself—and the redecoration of the entire exhibition hall. Suffice it here to consider in some detail the enlargement of the exhibition tanks. These were all too limited to make possible the kind of exhibits of which Dr. Townsend dreamed. Although the impossible white tiling had been eliminated, there was still much to be desired. Those original tanks had been built of common brick in a day before poured concrete had come into extensive use. Experimentally one tank was withdrawn from the circulation and emptied. The back was knocked out and the sides extended to the limits of the rear wall—a distance of eleven feet. This experimental work was all done by our own employees as time could be stolen from routine duties. Although none was exactly a trained concrete worker, this tank is still in service and has stood the test of years as well as any that were subsequently installed by contractors. The first tank was so successful that by virtue of continued struggle the Director was able to raise money to have the remainder of the wall aquaria enlarged in a similar manner. Only after this increase in size of exhibition space was it possible to exhibit certain of the larger specimens in a satisfactory manner.

To recite in full all the varied changes that were effected from time to time under the guiding hand of Dr. Townsend would make these remarks more nearly resemble a catalogue of items ranging from shipbuilding to house wrecking than a review of the activities of the first director of the Aquarium under the aegis of the New York Zoological Society.

A few more cannot be passed over, however. The old steam-pumping plant was moved and changed to an electric one. This released space made it possible to install our two largest aquaria and to create, on the gallery above them, an exhibit of small standing aquaria for the diminutive tropical fresh-water fishes which have since become so popular for keeping in the home. The construction problems involved demanded extensive alterations which took a long time to effect.

Another major change included the erection of a third story for offices, a library and laboratories. Construction problems on this project disorganized the peaceful operation of office work for about a year. However, as a result we obtained more adequate office space, a place to keep the necessary reference works, a satisfactory photographic dark room and two rooms planned to serve as laboratories.

While all these various items and many more not mentioned were being brought to pass, in most instances only by dint of continual and ceaseless driving in the face of apathy or active opposition, Dr. Townsend managed to find time to continue his studies in natural history. Prior to his assumption of Directorship of the Aquarium he had spent much time in the field, chiefly as Resident Naturalist attached to the now historic ship *Albatross*. This vessel, designed for the pursuit of oceanography, was operated by the United States Bureau of Fisheries most actively during the late 'Nineties and carried Dr. Townsend to remote places both in the arctic and the tropics. A discussion of the travels and work of this earlier phase of his life would fill many more pages than are here available. To understand the work of the man at the Aquarium, the background he brought with him must to some extent be indicated, for it colored his attitude to his institution as well as his publications and studies.

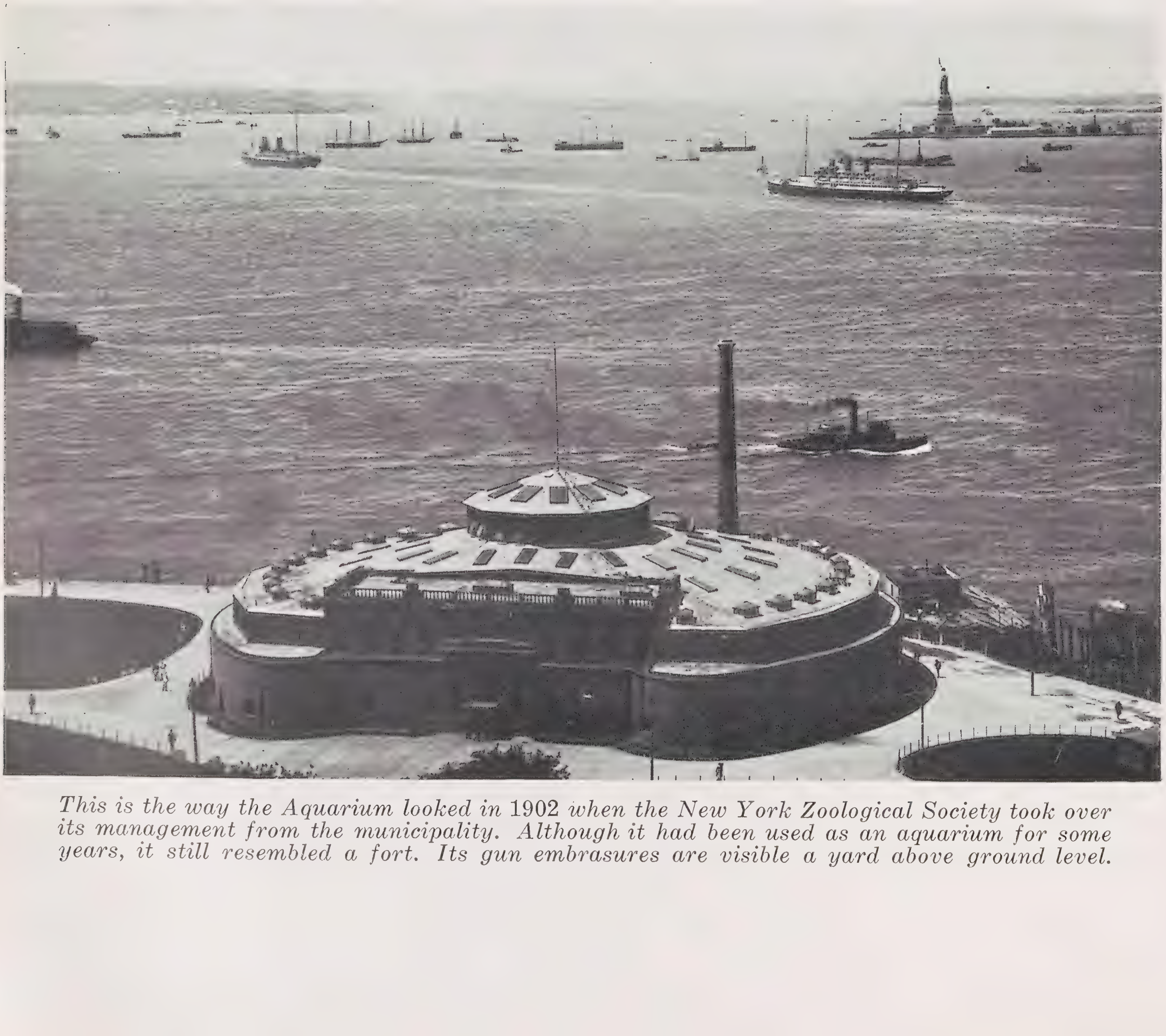
His long travels on the *Albatross* implanted a deep and abiding interest in oceanic life. The intellectual tree of the seed so planted is still continuing to bear fruit, with no sign of abatement. Seals and sea-lions received a large share of attention in his government work, culminating in his attendance as technical expert at The Hague Tribunal when international negotiations were under way concerning the fur seal of the North Pacific. These animals, then threatened with extinction, are now in a thriving condition and net the individuals and nations involved a handsome return. This most successful conservation treaty is largely based on the field studies of our retiring Director. Since then papers on seals and their relatives have come from his pen from time to time, covering both popular and technical items.

The great whales and their conservation have long been a source of interest to him and his most recent major contribution has been the publication of distributional charts of whale captures, based on the log books of old-time whalers.

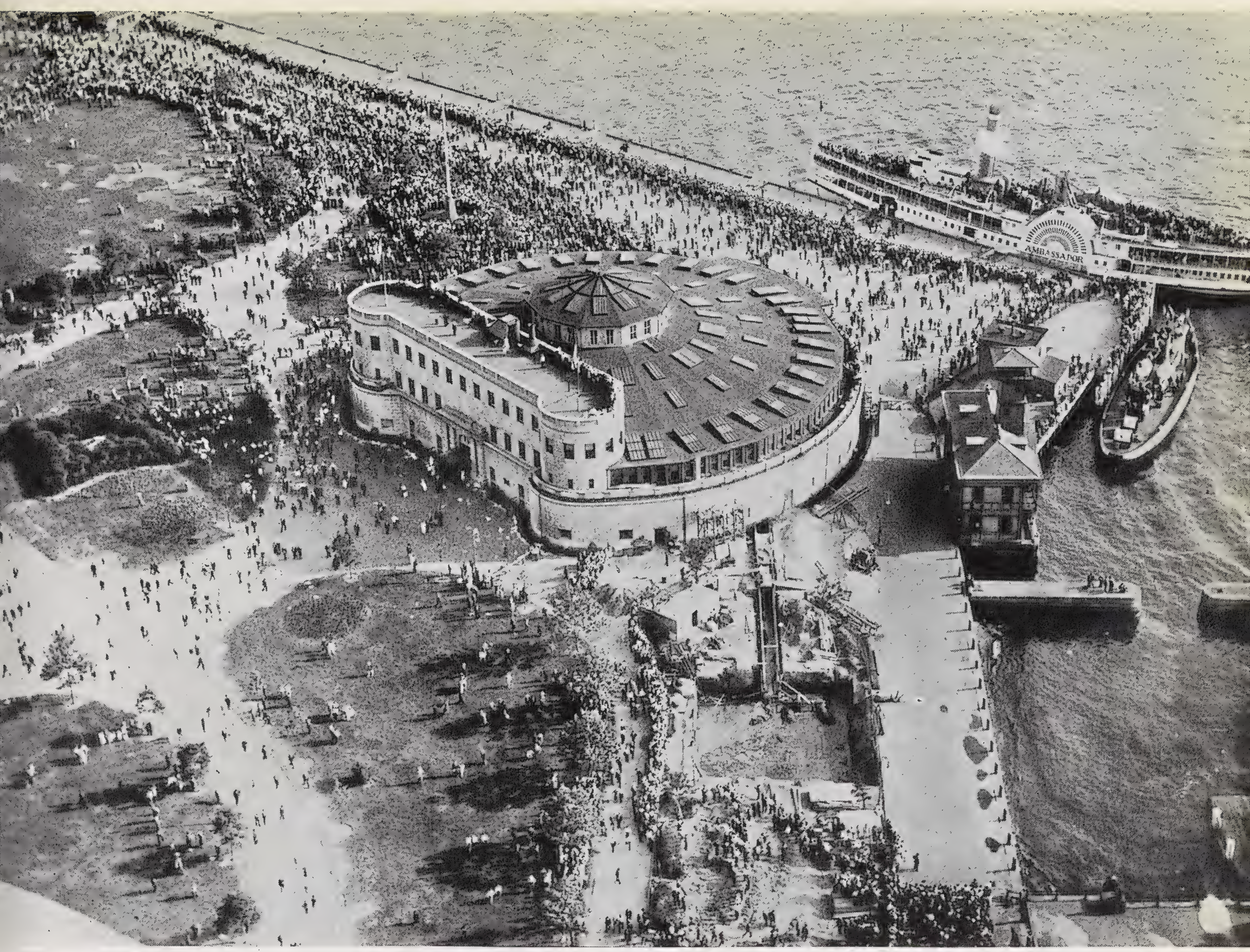
Before his connection with the New York Zoological Society, Dr. Townsend was involved in the establishment of the now commercially successful reindeer herds and more recently has concerned himself with studies on the growth and reproduction of the threatened Galápagos tortoises.

These matters may be taken as the backbone of his biological interests. However, so numerous have been his contributions to this *Bulletin* and on such varied subjects that any attempt to review them here would be too lengthy.

More technical papers include contributions to *Zoologica* and similar publications on color changes in fishes, the management and operation of a public aquarium, pond fish culture and so on. The guide books to the Aquarium have always come from his pen, the last appearing



This is the way the Aquarium looked in 1902 *when the New York Zoological Society took over its management from the municipality. Although it had been used as an aquarium for some years, it still resembled a fort. Its gun embrasures are visible a yard above ground level.*

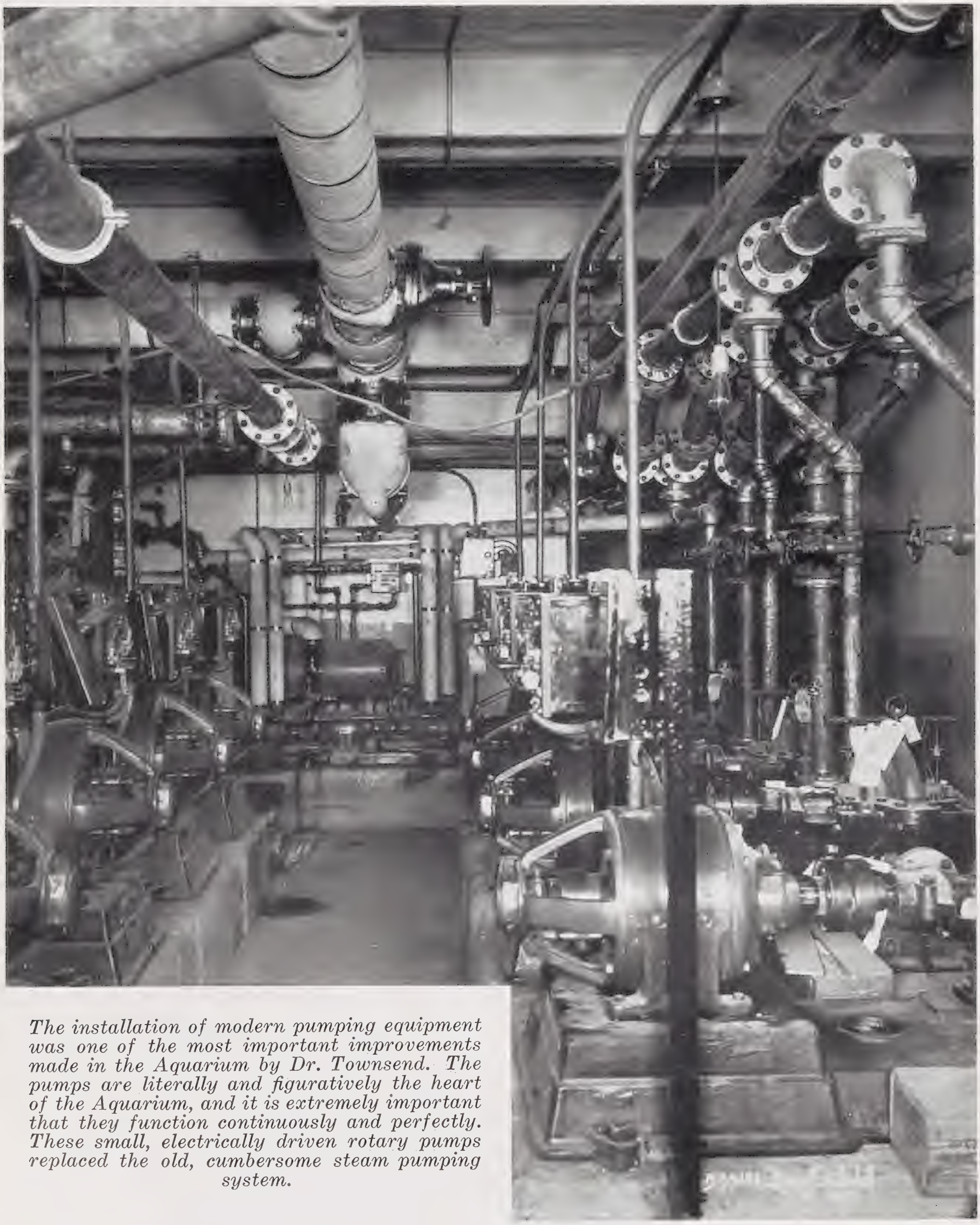


A striking view of the Aquarium as it is today, after the remodelling carried out by Dr. Townsend. This picture was taken by a New York World-Telegram *photographer on May 31, 1934, when the Navy came to New York. On that day 50,640 persons visited the Aquarium.*

less than a month before his retirement. The annual reports, up to 1927, were likewise written by him. At that time, in passing the task along to the writer of these remarks, he commented that twenty-five years of annual reports was enough to expect from any one man!

All these things, together with the necessity of keeping his fingers on the pulse of the institution, meant an end to most field work. While he never complained about the situation, one could sense, from time to time, an internal chafing and longing for the old ways of life, principally in some form of nostalgia for the open sea. Nevertheless a small amount of field work was continued, his two most recent trips being to the Galápagos Islands, the first on the *Albatross II,* a small ship in no way to be compared with the original *Albatross,* and the second aboard Mr. Vincent Astor's *Nourmahal.* Both of these were in the interests of his studies on the Galápagos tortoises.

During 1910 and 1911 Dr. Townsend was borrowed by The American Museum of Natural History in the capacity of Acting Director and he was president of the American Fisheries Society in 1912. The degree of Doctor of Science was conferred upon him by Washington and Jefferson College in 1909. One could go on for many pages enumerating his various commissions, honors and connections. Aside from the fact that a full listing would be unwelcome here, because of his retiring nature, a complete inventory of his accomplishments is impossible. Many are neither recorded in the usual reference books, nor easily brought out in conversation. While willing to talk freely on his field work and to reminisce broadly on all sorts of items of biological, geological or ethnological



The installation of modern pumping equipment was one of the most important improvements made in the Aquarium by Dr. Townsend. The pumps are literally and figuratively the heart of the Aquarium, and it is extremely important that they function continuously and perfectly. These small, electrically driven rotary pumps replaced the old, cumbersome steam pumping system.

interest, or on ship lore, it is like pulling teeth to attempt to get a full reply on Dr. Townsend's personal triumphs.

One of the natural questions that Dr. Townsend's friends may ask at this time, is: What of the future of such a man after his retirement?

Perhaps "retirement" is the very worst word to use in connection with Dr. Townsend. Certainly there is nothing in his mind, or in the thoughts of the Executive Committee of the Society, that implies a reward of "loafing" for years of service. Rather it should be looked upon as a relief from an onerous task in order to release a pent-up volume of work.

As anyone knows who has had the slightest connection with public aquaria, the work of operation is fraught with many headaches in the very nature of things. Dr. Townsend himself often pointed out that the directing of other public museums is relatively a sinecure. The director of a museum of art or natural history may rest peacefully enough at night, secure in the knowledge that on turning the key his charges will remain secure until the morrow—barring, of course, fire or earthquake or theft. The director of a zoological or botanical garden is not quite so well off, for there is always danger of disease and epidemics and frosts and in the former's case, fighting animals. But the aquarium director has all of these causes for concern, and a variety of others peculiar to his type of institution. Since the very heart of his museum is literally and figuratively a pump, or many pumps, a short period of failure in their operation may well spell disaster. The whole collection is at the mercy of the engineering department. While elaborate safeguards are of course provided, no mechanical system is perfectly protected against every combination of events—as witness the fatal accidents that sometimes occur even in our modern transportation systems with their extremely ingenious safeguards.

If, for example, a poisonous substance were inadvertently dropped into a cage of animals, at worst only the inhabitants of that particular cage might be destroyed. But if an equivalent substance entered the circulating water system of an aquarium, it would spread throughout every tank and more than likely destroy the inhabitants of the whole system before anything could be done about it.

Possibilities of disasters of this sort could be listed almost indefinitely, and the thought of them is seldom absent during an aquarium director's waking or even sleeping hours. Thus it is that with true appreciation one can write of "relief" for a man who has carried those responsibilities for thirty-five years. For it was exactly that long, from November 2, 1902, to November 1, 1937, that Dr. Townsend carried them. During that time 74,387,887 visitors viewed the displays that he spent so liberally of his ability in providing.

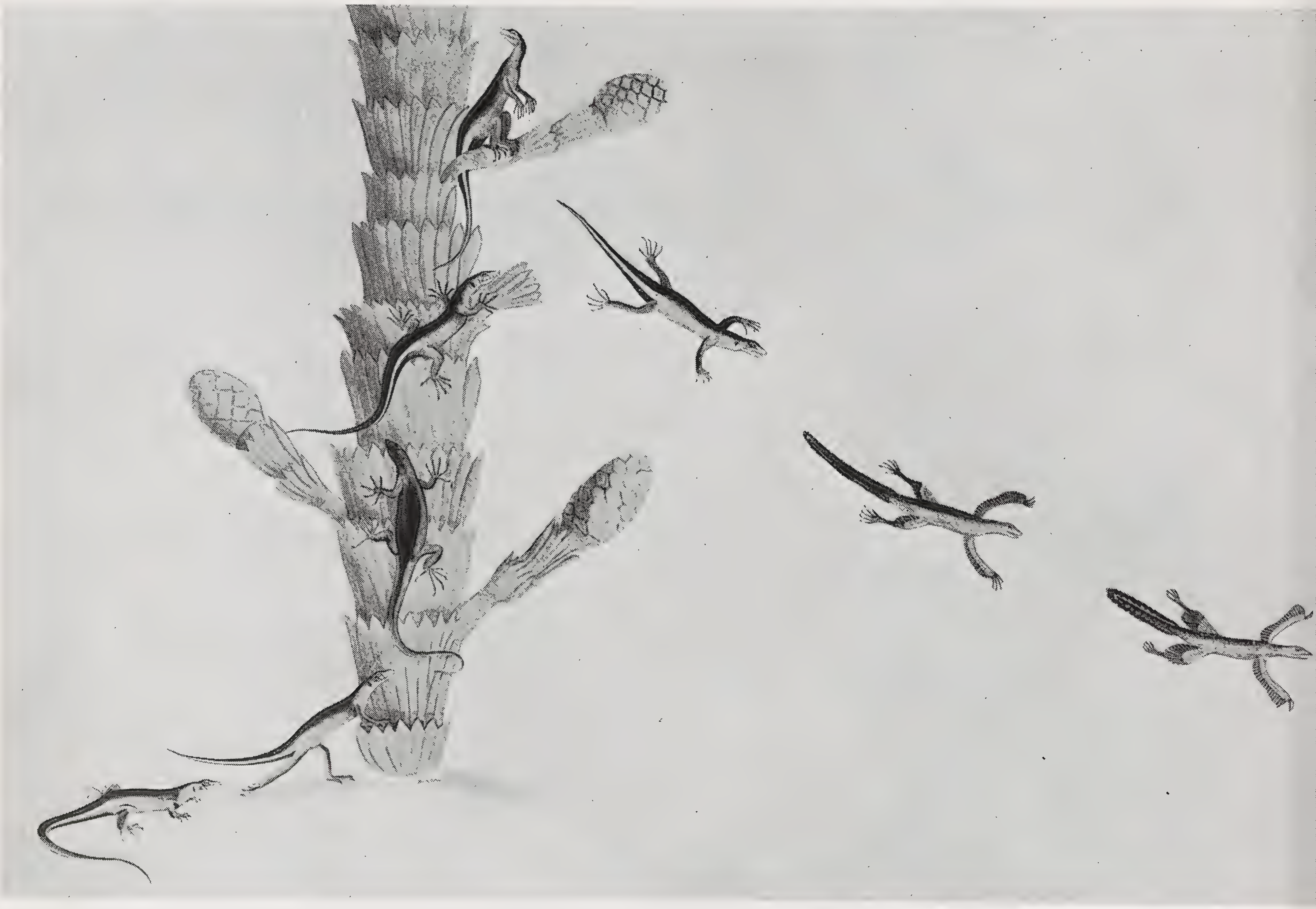
What, then, is to be released by the letting up of this pressure of an omnipresent fret? The plans of Dr. Townsend include principally a gathering together of his various lines of study with a more vigorous prosecution of them. One of the immediate items is the further study of whalers' logs covering whaling stations not yet examined. These include the California and Scottish whalers, now that he has the time to travel more extensively to examine them.

The studies of the Galápagos tortoises in the various colonies in the southern states will continue with more vigor, which is important since the animals are now rapidly reaching maturity.

By virtue of the trips made relatively recently and the earlier Bureau of Fisheries expeditions, Dr. Townsend has probably spent more hours ashore on the Galápagos islands than any other living naturalist. There are many things as yet unpublished about the natural history of these biologically interesting islands that we all hope he will put into permanent form.

These things and many others then, will occupy the days of that Dean of Aquarists, Dr. Charles Haskins Townsend, who relinquishes the post of Director of the New York Aquarium to pursue and publish on natural history unimpeded by day-to-day institutional problems.

C. M. Breder, Jr.



Drawing by George Swanson

This is the drawing that, greatly enlarged, has been installed in the Bird House. It shows the progressive steps by which the power of flight developed. The changes in form and structure took place over a long period, and were perhaps two hundred million years in the making.

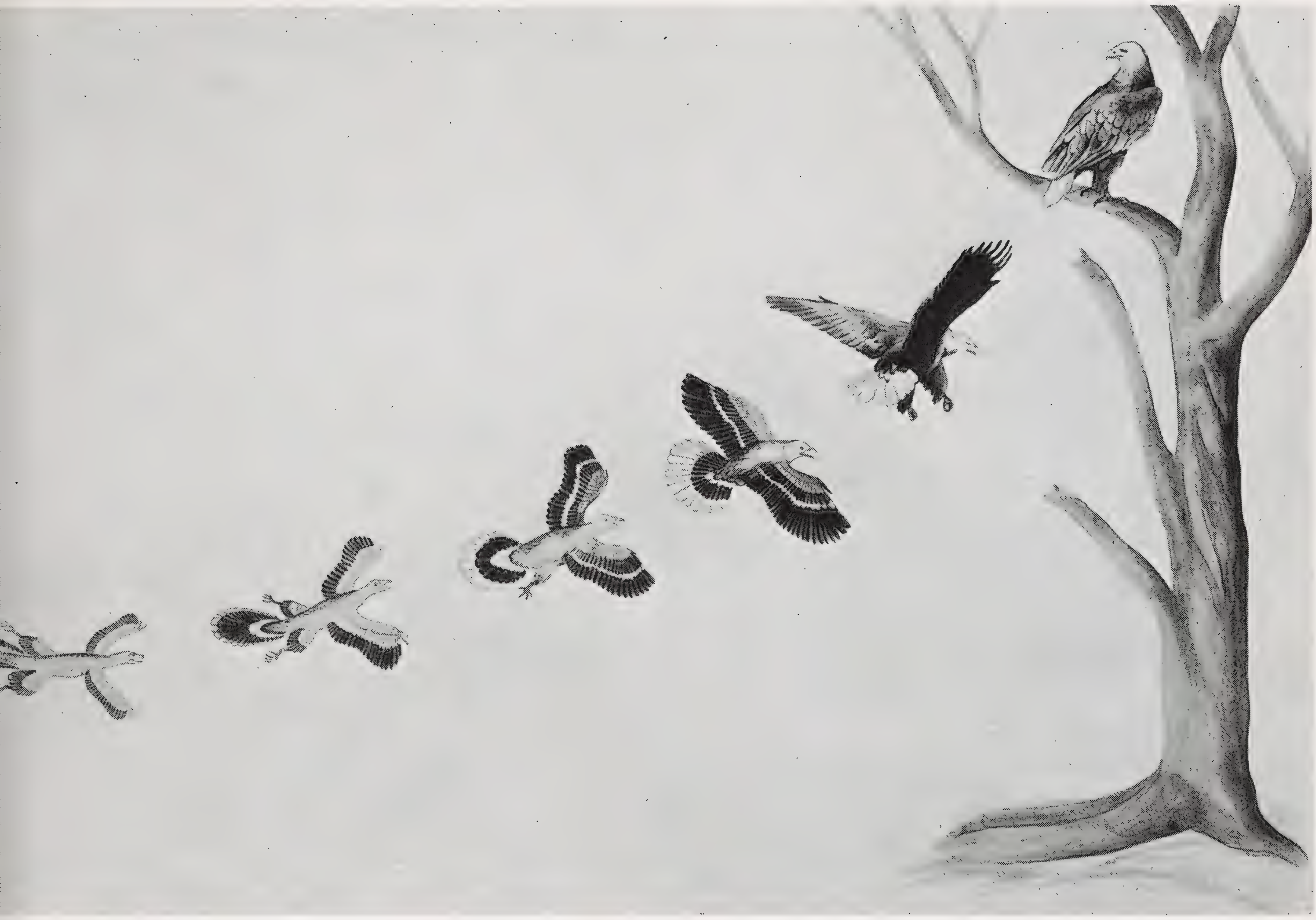
Why Do Birds Have Scales on Their Legs?

The Answer will be Found in Events Millions of Years Ago, and Is Graphically Presented in a New Drawing Set Up in the Bird House

WILLIAM BEEBE

AT the Annual Meeting of the Zoological Society in January, 1937, I showed an animation film in which I endeavored to illustrate the process by which lizards had evolved into birds in the course of the last thousands of milleniums. At the suggestion of Mr. Fairfield Osborn, I have had my artist, George Swanson, make a three-by-ten-foot drawing of this evolution, and have placed it on exhibition in the Bird House of the Zoological Park, under the caption "Why Do Birds Have Scales on Their Legs?"

About two hundred millions of years ago there were many kinds of reptiles, and especially lizards, living on the Earth, but no birds. Lizards, then as now, were continually trying out various new methods of life activities. Some ran rapidly and learned to increase their speed still more by rising on their hind legs (like the modern frilled lizard of Australia). Others climbed trees and (like the Mexican iguanas of today) instead of clambering all the way down again, leaped out into the air, and by flattening the skin of the body and legs somewhat broke



their fall, so that when they crashed down into low shrubs and bushes, they were uninjured.

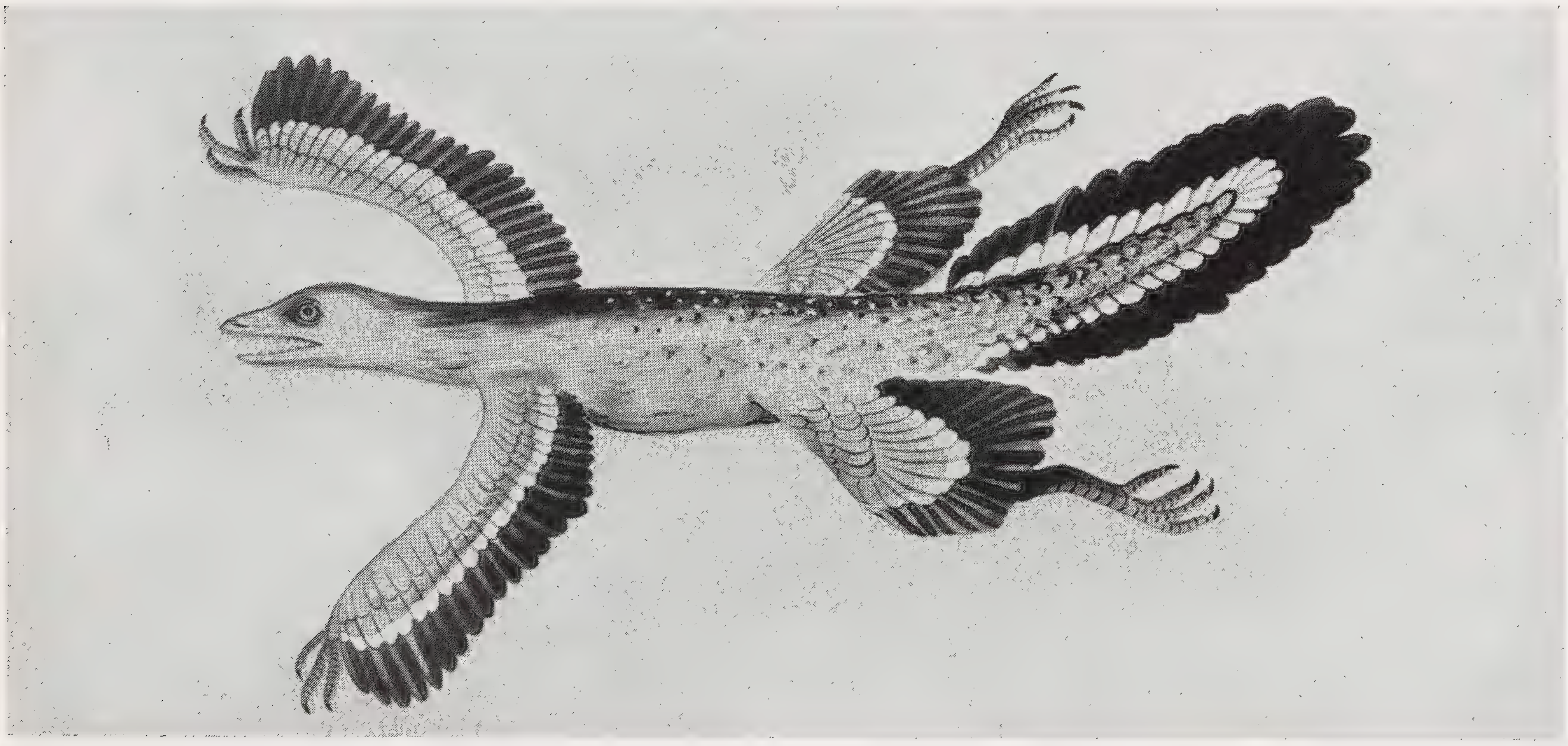
Thus in the days of old we find the beginnings of flight, and in some ancient lizard this gliding was aided by the outward growth of scales along the contour of the legs, body and tail. When these were long enough, a looping from tree to tree became possible, like the flying dragon lizards of the Malay States. Only, these glide by an extension of skin, not between the fore and hind limbs like flying squirrels, but membranes supported by the ribs.

Neither of these two latter methods could ever be carried further and become true flight, but in the long-scaled lizards of old, the parachutes became more and more efficient, and the freedom of the forelegs permitted a fluttering, which in time became a flapping. The two hundred million-year-old lizard changed gradually into a flying creature, and their descendants, living with us today on the Earth, we call Birds.

There seems little in common between the wonderfully delicate and downy eyed feather of the train of a peacock, and the scale of a fish or a lizard. The color difference, however, is of no importance, as we find just as gorgeous patterns and hues on lizards as among birds. As to structure, if we take a scale and, with a sharp knife, carefully slit it into dozens of fine filaments, we have, to all intents and purposes, a feather. In fact, if we examine the flattened, horny scales of a penguin, we will see how feathers can partly return, superficially, to an ancestral structure, lizard or fish-like, when an altered habitat is adopted.

Where this change of lizard into bird took place, we do not know. But as to time, if we take the earliest hints of human history and multiply them forty thousand times we will arrive, approximately, at the sunny afternoon in the Permian when the first lizard launched out upon the intangible air.

We find, as I believe, a small, rather slender reptile, covered with scales, with long tail, a delicate jaw filled with teeth and five digits on each foot. The changes, as I have endeavored to show both in motion pictures and in stills, included the slow lengthening of scales, especially along the back of the limbs and along the tail; the gradual transformation of the lizard mouth into a toothless, horny beak; the extreme increase of scale-feathers on the fore-limbs until the fingers were smothered, and ultimately hidden or lost (your roast chicken shows the remains of three); then followed the shortening of the tail from an elongate, feather-edged appendage to a compressed fan, a most efficient rudder.



This drawing, enlarged from the complete panel on Pages 20 *and* 21, *shows one of the intermediate stages in the development of flight. The creature is still as much lizard as bird.*

Although, for convenience, I have shown this whole evolution taking place in the course of a single flight from tree to tree, yet perching and climbing occupied a great part of every day in the life of every link. And this was the one thing which the ancient lizard and the modern bird had in common. So there could be but little change in the feet and legs, and today we have scales present in both groups; the legs of birds are almost lizards' legs.

The changes I have mentioned, while all-important, are only external and visible ones, and increased activity and flight could never have been achieved without radical internal alterations. Just as weight and power in an automobile must differ radically from those essential to an airplane, so a ground-walking creature shifting into a flying one had to give up solid bones and develop a skeleton filled with air; and the old double-valved heart driving cold fuel blood had to be replaced with a super-charged, four-chambered heart and circulating fluid heated to 110° or more, a fever temperature which would burn up our bodies in no time.

If we had to depend upon the testimony of the rocks, upon casual and fragmentary fossils, this evolution might be considered more theory than fact. But in addition to feathered, long-tailed and toothed fossil birds, we have living hoatzins in South America whose young still climb about with the aid of three large finger-claws, and in squabs the transitory and secondary thigh wings are so well developed that they show the first color of any of the body feathers.

If our efforts at showing the dramatic marvel of this magical transformation result in sending children home from the Zoological Park after having looked with more interest and attention at the collection of living birds, and primed with such an amazing and challenging question-whose-answer-is-known, as "Why Do Birds Have Scales on Their Legs?"—then our first experiment in this direction will have proved to be a success.

Other presentations of the evolution of vertebrates, from fish to mammals, answering such questions as "Why is a Whale?" are planned for the future.

The Species of Fish in New York Harbor

In the Past Eighteen Years the Aquarium Well-boat Has Recorded 129 Kinds, but Additions to the List Are Rare Now

C. M. Breder, Jr.

THE problem of the pollution of New York Harbor by sewage and factory wastes is perennial, and in view of the current discussion of the matter it is of interest to scan the records of the fish population of our harbor waters that the Aquarium has accumulated over a considerable number of years.

In 1920 the well-boat *Seahorse* was put into operation by the Aquarium and each year since then has rendered valuable service. Its area of activity has been the Lower Bay, where commercial fishing is still carried on. This region, sometimes known as Sandy Hook Bay, is roughly triangular in shape by virtue of the jutting arm of Sandy Hook, from which an imaginary boundary line may be drawn to the mouth of the Raritan River.

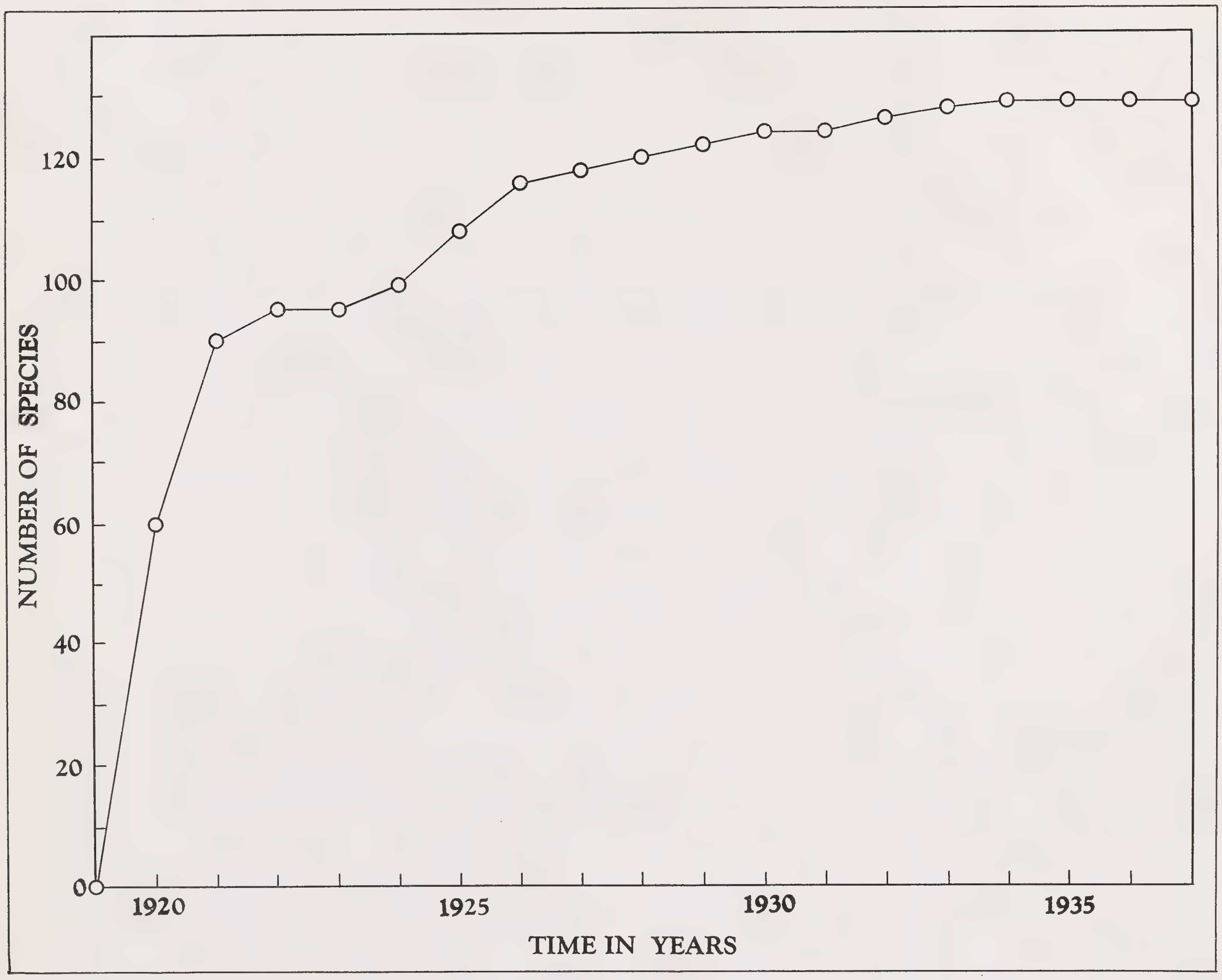
Among the records kept of the activity of this small but useful vessel is a complete list of the species of fish encountered by it. The first, that of the year 1920, was published in the 25th Annual Report of the New York Zoological Society, by Dr. Townsend. Since then the writer has published additional notes of this nature so that the full record is available in the technical literature of fishes.

The number of species that have been taken in this area, a scant twenty miles from the Battery, will be a surprise to many, since at this writing it stands at 129. The list of species is given at the end of this article. The occasion for writing this note at this particular time is that for the past four years the number accounted for has remained at 129, whereas formerly never more than one year elapsed without some addition being made. While other stragglers will surely arrive from time to time, it seems most unlikely that any large number of additions will be made to this list. This is especially clear if the chart showing the progress of additions be consulted. Here the decreasing nature of the additions becomes very apparent and the line of increase is certainly closely approaching the horizontal, or as the mathematicians would have it, the curve is approaching its asymptote.

A list of fishes published in 1926, including all known forms of marine species from southern New England and New York, enumerated 261. Our tiny triangular bay, a small fragment near the southern limit of this area, thus has received more than 48 per cent. of them and since that time has added one to the larger area's list—the gizzard shad. Thus, in spite of pollution, the Lower Harbor still contains a variety of fishes, many of which were formerly to be found in the Upper Harbor, and presumably would reenter it as soon as the extreme pollution was removed. It was as though they were pushed outward by a considerable effluent, but their natural resistance to dislodgment held them off no further than absolutely necessary. While the hope of return of these fishes, many of food and angling value, could hardly be used as an important argument for the elimination of New York's disgraceful harbor condition, the change would certainly be welcomed by many.

Certain fishes, as for example the spot, are more or less cyclic in their abundance. These at the height of their periods still invade the harbor in quantities. As with most such animals, they seem to be driven on by some impulse that recognizes no obstacle. Consequently, they swim into the harbor at such times, to whatever fate awaits them.

The Aquarium staff is perhaps more painfully aware of the harbor situation than most persons, since the conditions have had such a



This chart shows the progress of additions to the list of species found in New York Harbor, based on the collections of the Seahorse *during a period of eighteen years. The line of increase is approaching the horizontal as the number of additions to the list declined in recent years.*

direct bearing on its problems. Originally the marine tanks were piped direct to the harbor and the mortality of the specimens was tremendous. One wonders what the conditions would be in the Aquarium today, with the increase of pollution over that of thirty-six years ago, if the change to a closed circulating system of sea water had not been made. It is, of course, impossible to measure these differences, since the necessary historical data was not taken. It is only fair to mention in passing, that even aside from the pollution, the harbor water is not very suitable for many species because of its relatively low density and its fluctuating nature, due to the tides and the proximity of the fresh water coming down from the Hudson River.

Old records, not fully comparable with the present, however, do give some idea of the change in conditions. No longer does piling become invested in a coat of living organisms, such as black mussels, etc. Usually only a thin coat of some struggling green algae is present.

So bad has the pollution become that a continual production of hydrogen sulphide gas is given off, and, escaping into the atmosphere, pollutes that too. On some days it is strong enough to be readily detected by smell. The nose rapidly adjusts itself to such a "steady" condition and is a notoriously unreliable guide. Air analysis has shown us that there is practically always a detectable amount outside the building and always a large amount inside. It so happens that this gas has an affinity for alkaline solutions and consequently continually adds sulphur to our stored water, thereby increasing the factors in the complicated business of keeping both fishes and public satisfied.

In 1897 Dr. T. H. Bean, at that time director of the Aquarium, published a paper in the *Bulletin* of The American Museum of Natural History (Vol. IX, pages 327-375) entitled "Notes upon New York Fishes received at the New York Aquarium 1895-1897." A comparison of his remarks with the present list is of interest in connection with a number of items. At the time of his writing it was possible to obtain a considerable number of species for Aquarium purposes at Gravesend Bay—a location well up in the harbor. Such a possibility has long since gone and with it the presence of trap nets in that locality. In Dr. Bean's paper there is a list of fishes from Gravesend Bay, prepared by Mr. W. I. De Nyse, then of the Aquarium staff, for the three years mentioned. This covers 87 species. Our list for the first three years of the *Seahorse* in Sandy Hook Bay comes to 95, suggesting that even in the 'Nineties a smaller variety penetrated the harbor to this point. The lower salinity here may well be responsible for this condition.

However, in the earlier three-year list of 87 species there are ten that we have not found during our eighteen-year survey. In addition to this there are two others mentioned in the text, presumably from other years. The twelve additional fishes follow:

1. Monkfish
   Squatina squatina (Linnaeus)
2. Spanish Sardine
   Harengula sp. (*Sardinella anchovia* C. & V.) ?
3. Ten-spined Stickleback
   Pygosteus pungitius (Linnaeus)
4. Great Amberjack
   Seriola lalandi Cuvier & Valenciennes ?
5. Runner
   Elagatis bipinnulatus (Quoy & Gaimard)

Pound net fishing is commonly employed in Sandy Hook Bay, and it is from such nets as these, through the courtesy of the commercial fishermen when the Aquarium well-boat Seahorse *makes its trips for specimens, that many of the records discussed in this article were made.*

6. Dolphin
    Coryphaena hippurus Linnaeus
7. Black Rudderfish
    Palinurichthys perciformis (Mitchill)
8. Sheepshead
    Archosargus probatocephalus (Walbaum)
9. Banded Croaker
    Larimus fasciatus Holbrook
10. Surgeonfish
    Teuthis lepatus Linnaeus
11. Flying Gurnard
    Cephalacanthus volitans (Linnaeus)
12. Boston Hake
    Phycis tenuis (Mitchill)

Of this list all but the ten-spined stickleback and the sheepshead may be dismissed as strays from other regions, which might be expected to straggle in at any time. However, that ten such would be found so far up in the harbor in such a short time, as compared with our longer period of observation closer to the open sea, bespeaks a considerable loss in the varieties entering the harbor between these two periods.

The ten-spined stickleback is really a brackish water form and it is not surprising, with the high concentration of pollution in creeks and ditches, that this species is now rare or completely absent. The last living specimens seen by the writer in local waters were in the Jersey City meadows, as a boy, around 1908. The other two species of sticklebacks are still with us, but they have a tendency to keep to regions of somewhat higher density and consequently less concentrated pollution.

The sheepshead, once a common summer fish, appears no more in the New York region. The last definite record is August 19, 1904. The reason for this strange disappearance is still a matter of conjecture.

The Spanish sardine recorded by Bean as *Harengula* sp. would almost surely seem to be what we now know as *Sardinella anchovia,* which strays more or less regularly from the south to Long Island.

The great amberjack is recorded in the list of De Nyse with a question mark, but is not so mentioned in the text by Dr. Bean. This fish might well be expected to stray into the harbor at any time. At its smaller sizes it closely resembles the banded rudderfish and although we have examined hundreds, none so far has been the amberjack.

If we consider the all-time list of species definitely recorded from New York Harbor, the total comes to 141, twelve of which have not been recorded more recently than 1897, although our more recent list spans nearly half of the time elapsed since then.

An attempt was made to consider the fluctuations of the shad fisheries of the Hudson River in this connection. For our purposes, however, the data available is, unfortunately, of such a nature that it precludes statistical analysis. Variable factors, such as the number of men and nets employed, law changes regarding the setting of nets, the effect of varying efforts at artificial propagation, and so on, make the case peculiarly complicated. Dr. J. Greeley of the State of New York Conservation Department was conferred with in this connection and his views on the question of analyses are essentially similar. About all that can be said at the moment is that shad fishing has increased notably in recent years. Other fishes taken with shad in the lower river are sturgeon, usually small; menhaden, anchovies and bluefish (snappers). These all must run through the harbor pollution.

The fishes in the list below were taken in the Hudson River by the New York State Survey for 1934[1] which covered the upper Hudson watershed, or by the 1936[2] Survey which covered the lower reaches.

Barn-door Skate*
Sea Lamprey*
Common Sturgeon*
Short-nosed Sturgeon*
Alewife*
Glut Herring*
Shad*
Menhaden
Common Anchovy
Smelt
Common Eel*
Common Killifish*
Bill-fish
Tomcod*
Fluke
Winter Flounder
Four-spined Stickleback*
Northern Pipefish
Common Silverside
Tide-water Silverside
Common Jack
Bluefish
Striped Bass*
White Perch*

The species marked with an asterisk were taken above Hudson, N. Y. All except the barn-door skate were likewise taken below that place which divides the 1934 from the 1936 survey. All but three of these species are clearly intrusions from the sea. The smelt, tide-water silverside, *Menidia beryllina* (Cope) and white perch may be permanent residents well above the harbor proper or in the case of the first and last may have dropped down from some not distant lakes in which both occur in a supposedly land-locked condition. It is possible that this is also true of some of the specimens of alewife. Perhaps the most remarkable is the barn-door skate which was reputedly caught by a fisherman not far from Albany in 1932.

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[1] Greeley, J. R. 1935. In supp. to 24th rept. (1934) : 88-101.
[2] Greeley, J. R. 1937. In supp. to 26th rept. (1936) : 85-103.

Old records of the Hudson River, which have not been rediscovered, include the following.

Dusky Shark. *Carcharhinus obscurus* (Le Sueur) (1881) Mearns.[3]
Northern Seahorse. (1895-1896) Mearns.
Two-spined Stickleback. DeKay.[4]
Hogchoker. Mearns.
Butterfish. (1882-1883) Mearns.
Crab-eater. (1876) Fisher.[5]
Spot. Mearns.

All of these are well above the harbor and some as far up the river as Albany. Although there is evidently still a considerable passage of fishes through the harbor, it would seem from this list that in the years gone by more kinds of fish entered and traveled further inland. The record of the dusky shark is seriously questioned, as it is quite unknown from the Lower Bay. It would seem much more likely that the New York ground shark was referred to in this connection.

It is difficult to guess what fishing conditions might be like today if the harbor and river were thoroughly cleaned up. Of this much we may be certain: the invertebrate fauna, now nearly obsolete, would certainly be expected to return, and with it such fishes as feed on sessile growths. It is to be noted that with the exception of the sturgeon, the above-mentioned species are all open water feeders. That is, they normally feed on small, suspended particles, plankton, or on other free-swimming fish. The sturgeon, driven on by their migratory instincts, very likely do not attempt to feed on the vile harbor bottom of largely industrial effluvia during their sojourn in this area.

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The sheepshead was once a common summer fish in the waters of New York Harbor, but it no longer appears here and the last record of its appearance goes back to August 19, 1904. Why it has so completely disappeared is still a matter of debate and conjecture among ichthyologists.

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THE FISHES OF NEW YORK HARBOR

LAMPREYS

1. Sea Lamprey*
   Petromyzon marinus Linnaeus

SHARKS AND RAYS

2. Smooth Dogfish†
   Mustelus canis (Mitchill)
3. New York Ground Shark
   Carcharhinus milberti (Muller & Henle)
4. Spot-fin Ground Shark*
   Carcharhinus limbatus (Muller & Henle)
5. Hammer-head Shark
   Sphyrna zygaena (Linnaeus)
6. Sand Shark
   Carcharias littoralis (Mitchill)
7. Mackerel Shark*
   Isurus tigris (Atwood)
8. Spined Dogfish
   Squalus acanthias Linnaeus
9. Common Skate†
   Raja erinacea Mitchill
10. Big Skate
    Raja diaphanes Mitchill
11. Clear-nosed Skate†
    Raja eglanteria Lacépède
12. Barn-door Skate
    Raja stabuliforis Garman
13. Sting Ray
    Dasyatis centrura (Mitchill)
14. Butterfly Ray*
    Pteroplatea maclura (Le Sueur)
15. Eagle Ray*
    Myliobatis freminvillii Le Sueur
16. Cow-nosed Ray
    Rhinoptera bonasus Mitchill

BONY FISHES

17. Common Sturgeon
    Acipenser oxyrhynchus Mitchill
18. Short-nosed Sturgeon
    Acipenser brevirostris Le Sueur
19. Ten-pounder*
    Elops saurus Linnaeus
20. Tarpon*
    Tarpon atlanticus (Cuvier & Valenciennes)
21. Sea Herring
    Clupea harengus Linnaeus
22. Alewife
    Pomolobus pseudoharengus (Wilson)
23. Hickory Shad
    Pomolobus mediocris (Mitchill)
24. Glut Herring*
    Pomolobus aestivalis (Mitchill)
25. Shad
    Alosa sapidissima (Wilson)
26. Thread Herring
    Opisthonema oglinum (Le Sueur)
27. Menhaden†
    Brevoortia tyrannus (Latrobe)
28. Round Herring*
    Etrumeus sadina (Mitchill)
29. Gizzard Shad*
    Dorosoma cepedianum (Le Sueur)
30. Striped Anchovy
    Anchoviella epsetus (Bonnaterre)
31. Common Anchovy
    Anchoviella mitchilli (Cuvier & Valenciennes)
32. Rainbow Trout*
    Salmo irideus Gibbons
33. Smelt*
    Osmerus mordax (Mitchill)
34. Common Eel†
    Anguilla rostrata (Le Sueur)
35. Conger Eel
    Leptocephalus conger Linnaeus
36. Gaff-topsail Catfish*
    Bagre marina (Mitchill)
37. Lizard Fish
    Synodus foetens (Linnaeus)
38. Rain-water Fish*
    Lucania parva (Baird & Girard)
39. Common Killifish†
    Fundulus heteroclitus macrolepidotus (Walbaum)
40. Bass Killifish†
    Fundulus majalis (Walbaum)
41. Sheepshead Killifish†
    Cyprinodon variegatus Lacépède
42. Bill-fish
    Strongylura marina (Walbaum)
43. Marine Gar*
    Tylosurus raphidoma (Ranzani)
44. Hound Fish*
    Tylosurus acus (Lacépède)
45. Halfbeak*
    Hyporhamphus roberti (Cuvier & Valenciennes)
46. Pollack*
    Pollachius virens (Linnaeus)
47. Tomcod
    Microgadus tomcod (Walbaum)
48. Codfish
    Gadus morrhua Linnaeus
49. Spotted Hake
    Urophycis regius (Walbaum)
50. Squirrel Hake†
    Urophycis chuss (Walbaum)
51. Silver Hake†
    Merluccius bilinearis (Mitchill)
52. Window-pane†
    Lophopsetta maculata (Mitchill)
53. Small-mouthed Flounder
    Etropus microstomus (Gill)
54. Fluke†
    Paralichthys dentatus (Linnaeus)
55. Four-spotted Flounder*
    Paralichthys oblongus (Mitchill)
56. Winter Flounder†
    Pseudopleuronectes americanus (Walbaum)
57. Hogchoker
    Achirus fasciatus Lacépède
58. Two-spined Stickleback
    Gasterosteus bispinosus Walbaum
59. Four-spined Stickleback†
    Apeltes quadracus (Mitchill)
60. Northern Pipefish†
    Syrictes fuscus (Storer)
61. Northern Seahorse
    Hippocampus hudsonius De Kay
62. Common Silverside†
    Menidia menidia notata (Mitchill)
63. Striped Mullet
    Mugil cephalus Linnaeus
64. White Mullet†
    Mugil curema Cuvier & Valenciennes
65. Northern Barracuda
    Sphyraena borealis De Kay
66. Eight-fingered Threadfin
    Polynemus octonemus Girard
67. Spanish Mackerel
    Scomberomorus maculatus (Mitchill)
68. Common Mackerel
    Scomber scombrus Linnaeus
69. Chub Mackerel
    Pneumatophorus grex (Mitchill)
70. Common Bonito
    Sarda sarda (Bloch)

71. Cutlass Fish*
    Trichiurus lepturus Linnaeus
72. Harvest Fish
    Peprilus paru (Linnaeus)
73. Butterfish†
    Poronotus triacanthus (Peck)
74. Goggle-eyed Scad
    Trachurops crumenopthalmus (Bloch)
75. Hardtailed Jack†
    Paratractus crysos (Mitchill)
76. Common Jack
    Caranx hippos (Linnaeus)
77. Threadfish
    Alectis ciliaris (Bloch)
78. Moonfish†
    Vomer setapinnis (Mitchill)
79. Look-down
    Selene vomer (Linnaeus)
80. Bumper
    Chloroscombrus chrysurus (Linnaeus)
81. Round Pompano
    Trachinotus falcatus (Linnaeus)
82. Common Pompano†
    Trachinotus carolinus (Linnaeus)
83. Banded Rudderfish†
    Seriola zonata (Mitchill)
84. Bluefish†
    Pomatomus saltatrix (Linnaeus)
85. Crab-eater*
    Rachycentron canadus (Linnaeus)
86. Striped Bass†
    Roccus lineatus (Bloch)
87. White Perch
    Morone americana (Gmelin)
88. Sea Bass†
    Centropristes striatus (Linnaeus)
89. Tripple-tail*
    Lobotes surinamensis (Bloch)
90. Gray Snapper*
    Lutianus griseus (Linnaeus)
91. Pigfish*
    Orthopristis chrysopterus (Linnaeus)
92. Porgy†
    Stenotomus chrysops (Linnaeus)
93. Pinfish
    Lagodon rhomboides (Linnaeus)
94. Bermuda Chub*
    Kyphosus sectatrix (Linnaeus)
95. Northern Goatfish*
    Mullus auratus Jordan & Gilbert
96. Silver Perch†
    Bairdiella chrysura (Lacépède)
97. Red Drum
    Sciaenops ocellata (Linnaeus)
98. Spot†
    Leiostomus xanthurus Lacépède
99. Croaker†
    Micropogon undulatus (Linnaeus)
100. Kingfish†
    Menticirrhus saxatilis (Bloch & Schneider)
101. Drumfish
    Pogonias chromis (Linnaeus)
102. Weakfish†
    Cynoscion regalis (Bloch & Schneider)
103. Spotted Squeteague*
    Eriscion nebulosus (Cuvier & Valenciennes)
104. Spadefish*
    Chaetodipterus faber (Broussonet)
105. Common Butterfly Fish*
    Chaetodon ocellatus (Bloch)
106. Brassy Sculpin
    Acanthocottus aeneus (Mitchill)
107. Eighteen-spined Sculpin†
    Acanthocottus octodecimspinosus (Mitchill)
108. Sea Robin*
    Hemitripterus americanus (Gmelin)
109. Lumpfish*
    Cyclopterus lumpus Linnaeus
110. Carolina Sea Robin†
    Prionotus carolinus (Linnaeus)
111. Striped Sea Robin†
    Prionotus evolans strigatus (Cuvier)
112. Cunner
    Tautogolabrus adspersus (Walbaum)
113. Tautog†
    Tautoga onitis (Linnaeus)
114. Naked Goby*
    Gobiosoma bosci (Lacépède)
115. Shark Sucker
    Echeneis naucrates Linnaeus
116. Off-shore Remora*
    Remora remora Linnaeus
117. Sand Launce*
    Ammodytes americanus De Kay
118. Stargazer*
    Astroscopus guttatus Abbot
119. Sand Eel*
    Rissola marginata (De Kay)
120. Toadfish†
    Opsanus tau (Linnaeus)
121. Common Triggerfish*
    Balistes carolinensis Gmelin
122. Common Filefish*
    Monacanthus hispidus (Linnaeus)
123. Orange Filefish†
    Alutera schoepfi (Walbaum)
124. Trunkfish*
    Lactophrys trigonus (Linnaeus)
125. Smooth Puffer
    Lagocephalus laevigatus (Linnaeus)
126. Common Puffer†
    Spheroides maculatus (Bloch & Schneider)
127. Spiny Boxfish†
    Chilomycterus schoepfi (Walbaum)
128. Ocean Sunfish*
    Mola mola (Linnaeus)
129. Angler
    Lophius piscatorius Linnaeus

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* Species marked with an asterisk are not regular and are mostly rare in the lower harbor.

† Species marked with a dagger form the backbone of the Lower Bay fauna and are regularly present for at least part of our fishing season—from May to November.

Other names without special marks fall between the typical and abundant species and the distinct rarities.

In Quest of the Quetzal

In the High Rain Forest of Honduras the Sacred Bird of the Aztecs Makes Its Home, and from There Came Our First Specimens

V. Wolfgang von Hagen

Honduras Expedition Under the Auspices of the Museum of the American Indian, Heye Foundation

WHEN I sailed for Honduras in June of 1937 to search for the Quetzal, I took with me all the data that I could find on the bird—and that was almost exactly nothing. Legends and stories there are in plenty, but they are of little use when one is attempting to capture living specimens. What I needed to know, and what I could not discover from books, was exactly where the bird nested, when it nested, how its young might best be captured and transported, what natural or artificial foods it would take, and innumerable other matters of that kind.

Of course, if the answers to those questions had been known long enough to be set down in reference books, probably the Quetzal would have have been captured and acclimatized and exhibited long ago, and thus my quest would have had none of the novelty that it possessed. For I was searching for a famed and beautiful bird that had never, since the days of the Aztecs four hundred years ago, been seen in captivity.

The legends of the Quetzal are fascinating, but they can be found in the encyclopedia and it is sufficient to note here that it was the sacred bird of the Aztecs and the Mayas, that its plumes appear in the Plumed Serpent motif in the ruins of Middle America, and that it is associated with Quetzal-coatl, the Culture-Hero of the Americas. I urge the reader to look up some of those legends and stories; they will well repay reading.

But to get on with my story of how we found the Quetzal, captured young birds, transported them through the jungle, and at last had the supreme satisfaction of receiving word that nine youngsters arrived safely in New York. All nine, incidentally, were consigned to the New York Zoological Park where they were to be somewhat more fully acclimatized before a part of the collection was trans-shipped to the London Zoo.

[Note: As reported in the November-December, 1937, *Bulletin,* three of the birds were retained here, and six were sent to London. One male, a magnificent specimen that is strongly showing its green-gold feathers, is on exhibition in the Bird House.]

The Republic of Honduras, where the Quetzals make their home, is an extremely hilly and mountainous territory bordering on Guatemala. We had reason to believe that somewhere on the high, dark and damp peaks of the range known as the Sierra de Pijol, in the Departmento de Yoro, we might encounter the birds we sought.

The beginning of the quest was comparatively easy. Guides were found among the Jicaque Indians of the region and we plunged into the forest. For the first few days the going was surprisingly but deceptively pleasant. The lower slopes were forested with pine and oak, and there was but little underbrush, so that we were able to ride in great comfort. The soft sweep of the breeze through the pines was more reminiscent of the Berkshires, indeed, than of the tropics, and except for the gray, moss-like *Tillandsia* that festooned every branch we might well have been back in the northern part of the United States.

But on the fourth day of this gradual ascent of the range, we came abruptly to the limit of the pine vegetation. We had climbed 4,500 feet and the sandy soil which supported that type of tree gave way to a black humus and an en-

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The thickly-wooded mountain peak in the distance is the Sierra de Pijol, and it is in the high rain forest near the summit of the mountain that the Quetzal must be sought. Here the mist drifts continuously through the cool forest and the sunlight breaks through only at intervals.

tirely different flora—and a decidely less pleasant method of travel.

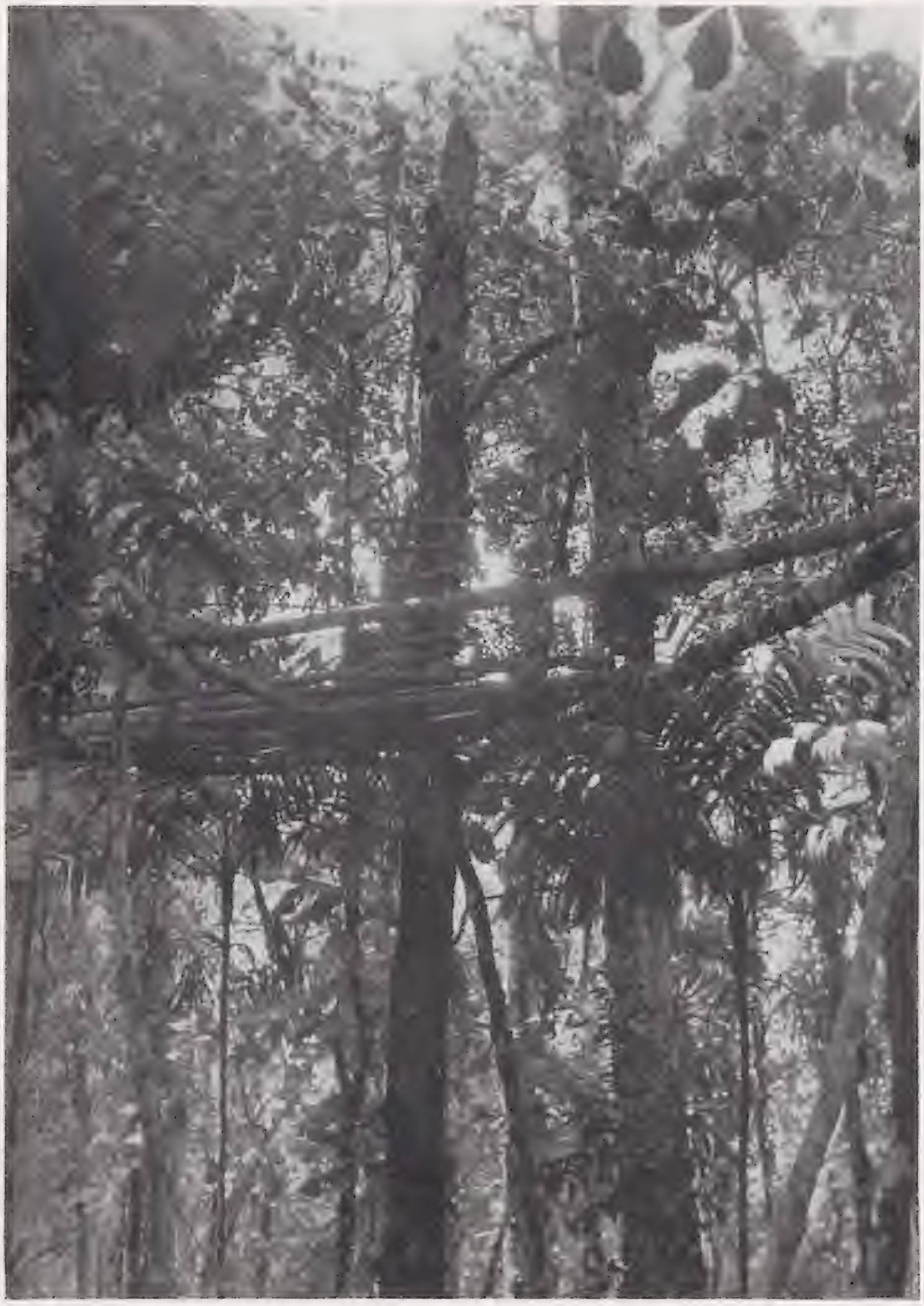
Here the dark, dank jungle began its domination and it was no longer possible to ride. Lianas trailed from every tree and impeded progress, aerial roots so strong that the Indians use them for cordage had to be hacked out of the way or pushed aside. Spiny plants barred our path. And for the greater part of the day and night, mist-laden clouds drifted through the giant trees and bathed our green world in perpetual dampness.

In this forbidding forest the Quetzal has its home and now the quest was beginning in earnest. Birds of great beauty flitted before us, startled from their nests or their feeding by the blows of our guides' machetes as they cleared a path. Toucans, strange woodpeckers, motmots, collared trogons (small but lovely relatives of the Quetzal) flashed above our heads, and now and again we heard the sweet note of the little solitaire, a bird whose voice is so beautiful that the Aztecs reserved special praise for it. Any time, now, we knew we might come upon the prize we sought, although we could hope for nothing more than a mere glimpse of it. Location of the nests and the capture of young specimens would, we knew, require a long siege.

In that land of almost perpetual gloom, where the sun broke through the mist so irregularly, we endeavored to find the bird by its call. At intervals through the day as our little party halted the Indians called to the Quetzal in its own language—a wild, strange cry rising higher and higher. Again and again we listened, but no answer came. No Quetzal took up the challenge; there was only the slow patter of dripping mist.

But then came the evening of our first camp in the bush, and the Indians were at work around the fire. Our ears caught nothing but the familiar sounds of the jungle at dusk, but the Indians signalled to listen, and out of the darkness, so close at hand that it might have been on the very edge of our encampment, came the raucous note of a bird, rising in that steep pitch we had heard during the day when the Indians attempted to imitate the Quetzal. But this was no imitation; this was the Quetzal!

In the fast descending darkness there was nothing we could do, but we knew we were on the right track and that patience must thenceforth guide us. It was but a few days later that we advanced the next step in our quest; we saw the Quetzal for the first time.



As each nest was found, platforms were built immediately under them from which observers could study the behavior of the birds. The nest hole in the trunk of the decayed tree is near the top.

We were following our Indians into the bush when one of them stopped suddenly and pointed to the branches of a wild avocado tree. *"Ampusay!"* he exclaimed. It was the native name for the Quetzal.

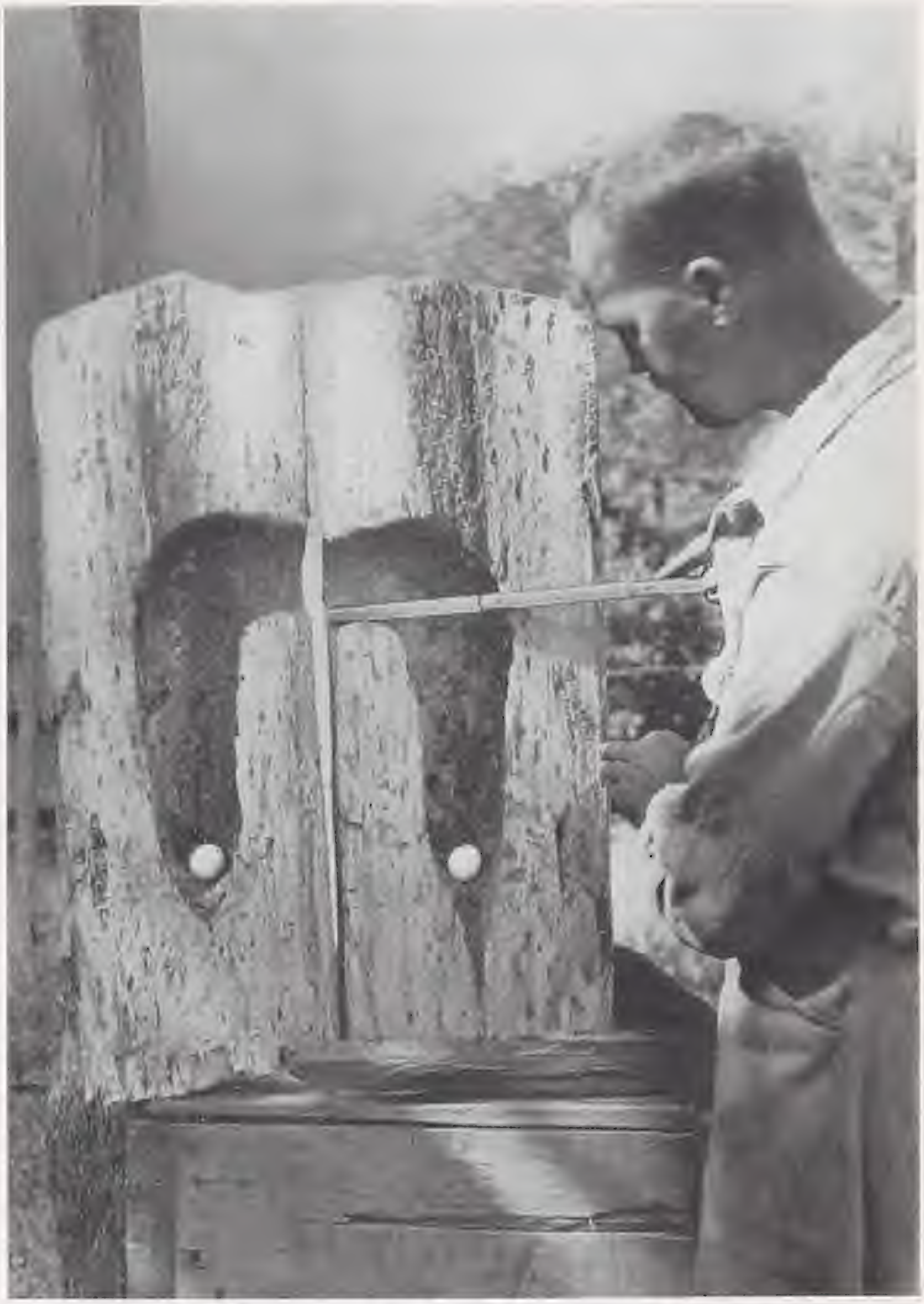
I looked; I stared; I searched the tree with my eyes, one shiny green leaf after another. Nowhere among its leaves and acorn-like fruit could I make out the outlines of the bird that apparently was perfectly visible to my guide.

Perhaps at last he took pity on my blindness, for he drew his blowgun and fired a pellet into the leaves. Simultaneously with its rattle one of the "leaves," more green, more shiny, perhaps, than the rest, detached itself and floated off through the air in a series of undulations and came to rest on a low branch nearby. In that brief flight, while I tore at my camera box and fumbled to change lenses, I noted the spread of the black and white tail and the indescribable beauty of the two long caudal plumes of iridescent green-gold. This was indeed a bird that was worth seeking!

That was our first and last sight of the bird for some time, although we heard them calling frequently. Our camp had to be changed; it was impossible to maintain it permanently in the almost ceaseless rain and mist, and so our base was transferred down the slope of the range to the drier lower altitude, and we resolved to search for the Quetzal only by means of light, swift journeys into the rain forest above.

From what little definite information we had picked up from the Indians, it seemed likely that this was the nesting season of the birds—and if so, the perfect season for our search. Events proved that the Indians and our deductions were right. For on one of our searches we came upon a small clearing. Some time not too long before a forest giant had toppled, and had carried a host of smaller trees with it. By chance there stood a single decayed trunk that the crash had spared. Woodpeckers had been at work on it, and my eye swept its length. There, some forty feet above ground, was a streak that glittered gold and blue and green in the stray sunlight. It was the tail plumes of the male Quetzal hanging from the nest! Clearly we could see the nest hole in the rotting wood, and the plumes limply protruding.

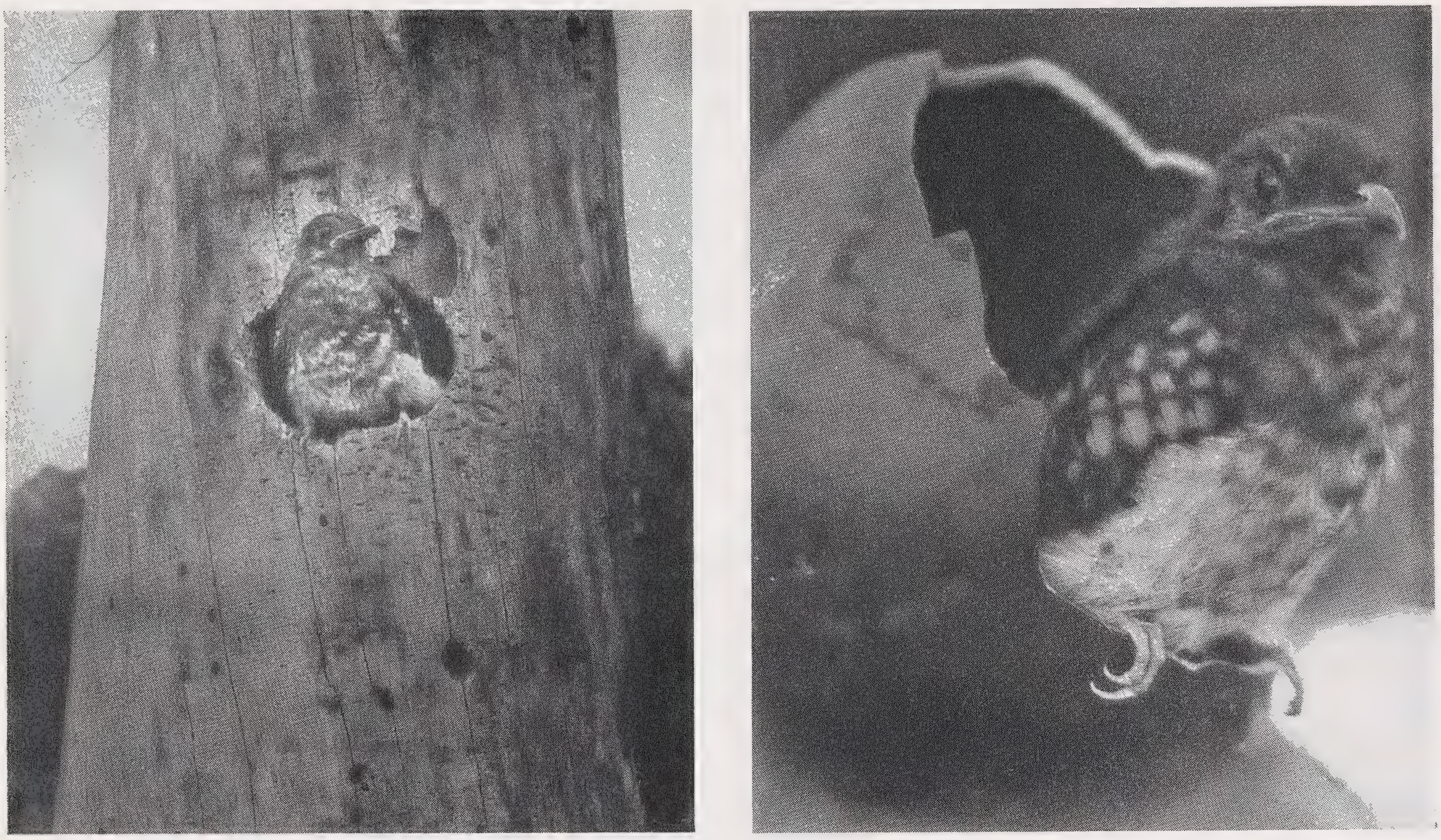
My cry of discovery caused the plumes to be drawn within the nest hurriedly, and a moment later the crested head of the bird appeared at the nest hole. We draw closer, and when we were a little distance away the Quetzal poised for an instant on the edge of the hole and then took slow, wavy flight to another tree from which he watched us.



A nest of one pair of Quetzals was cut out of the tree and sawed in half to show that, contrary to old legends, the nest actually has only one hole. Hen's eggs here show their respective positions.

Now at last I felt that our quest was destined to succeed, for chance alone had to lead us to the nest and I felt sure that once we found nestlings, our part of the task would be comparatively easy. Birds fully as rare and as delicate had been kept in captivity; legends aside, I saw no reason why the Quetzal should not respond also to proper care and treatment.

The handicraft of my Indians came in for instant testing. They constructed a shaky, uncertain platform by which I managed to reach the height of the nest. By a flashlight held within the deep and dark cavity I saw two large, bluish eggs. They lay, uncushioned by any nesting material, on the floor of the hole, in the soft dèbris of the decaying wood. A moment's examination of all sides of the trunk in the area of the nest served to dispel one legend—that the Quetzal's nest has two holes, one for ingress and one for egress, so as not to have to turn within the nest and risk breaking the plumes of the male.



The young Quetzal at the left emerges from the nest hole and surveys the world for the first time, preparatory to making an experimental flight. (Right). A gourd proved unsatisfactory as a substitute nest for this youngster, who preferred to perch on the edge.

Incidentally, it appears that the male Quetzal is not too elaborately careful of the plumes that are his chief beauty, for several times in the forest we found plumes that had broken off—not moulted off.

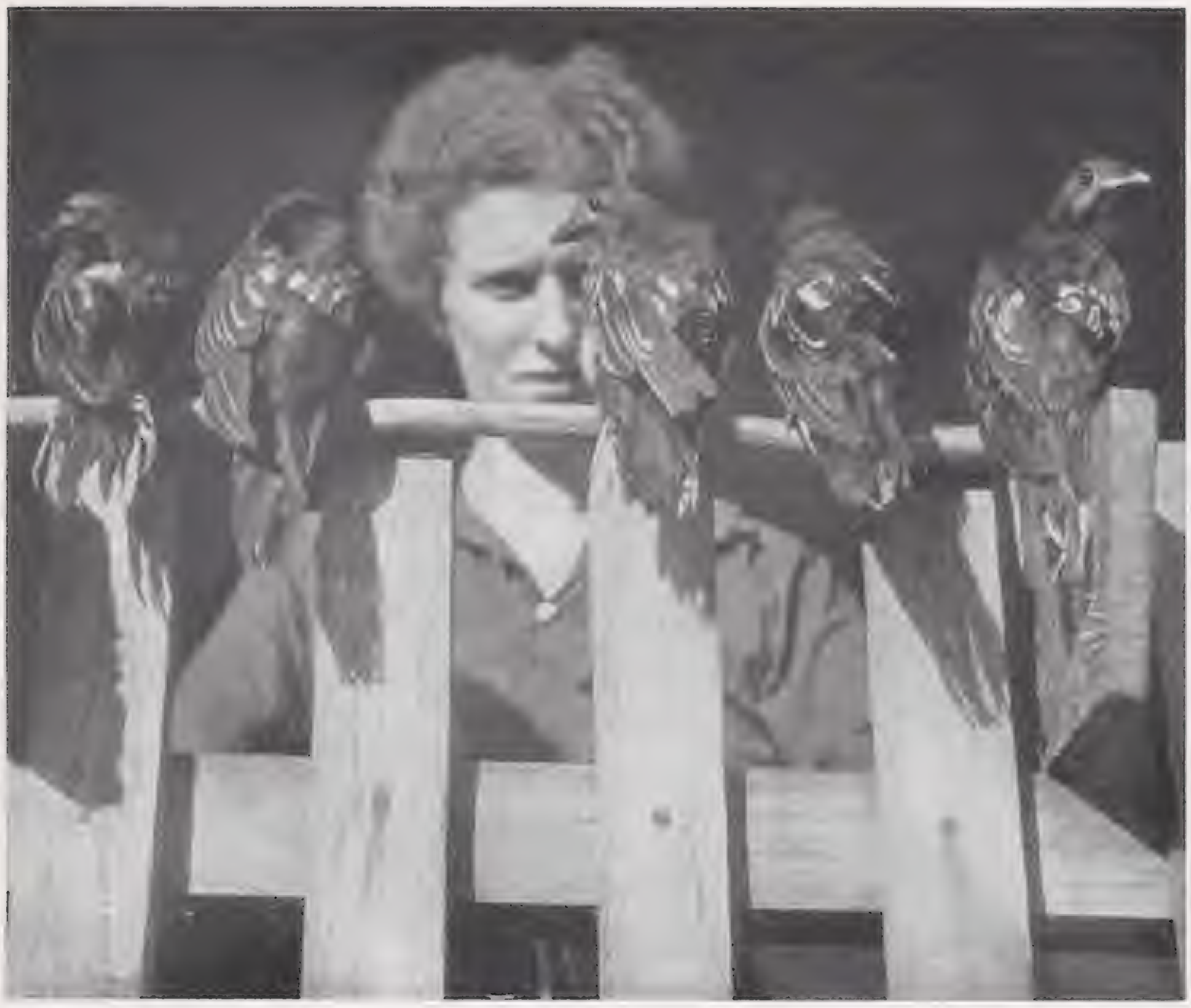
After the first excited examination of the nest I had the Indians build a more stable platform nearby, from which we could carry on daily observations of the comings and goings and the habits of the birds. Both the male and the female attended the nest, and when the eggs hatched their comings and goings were more frequent. At dawn, after a night spent hovering the young birds, the female departed to feed, and at about 9 o'clock in the morning the male came swooping in to regurgitate into the mouths of the hungry young birds the food he had gathered.

Both parents were kept busy during the day, and in the intervals of their absence we could plainly hear the hissing and gurgling of the babies—their incessant cries for food and more food.

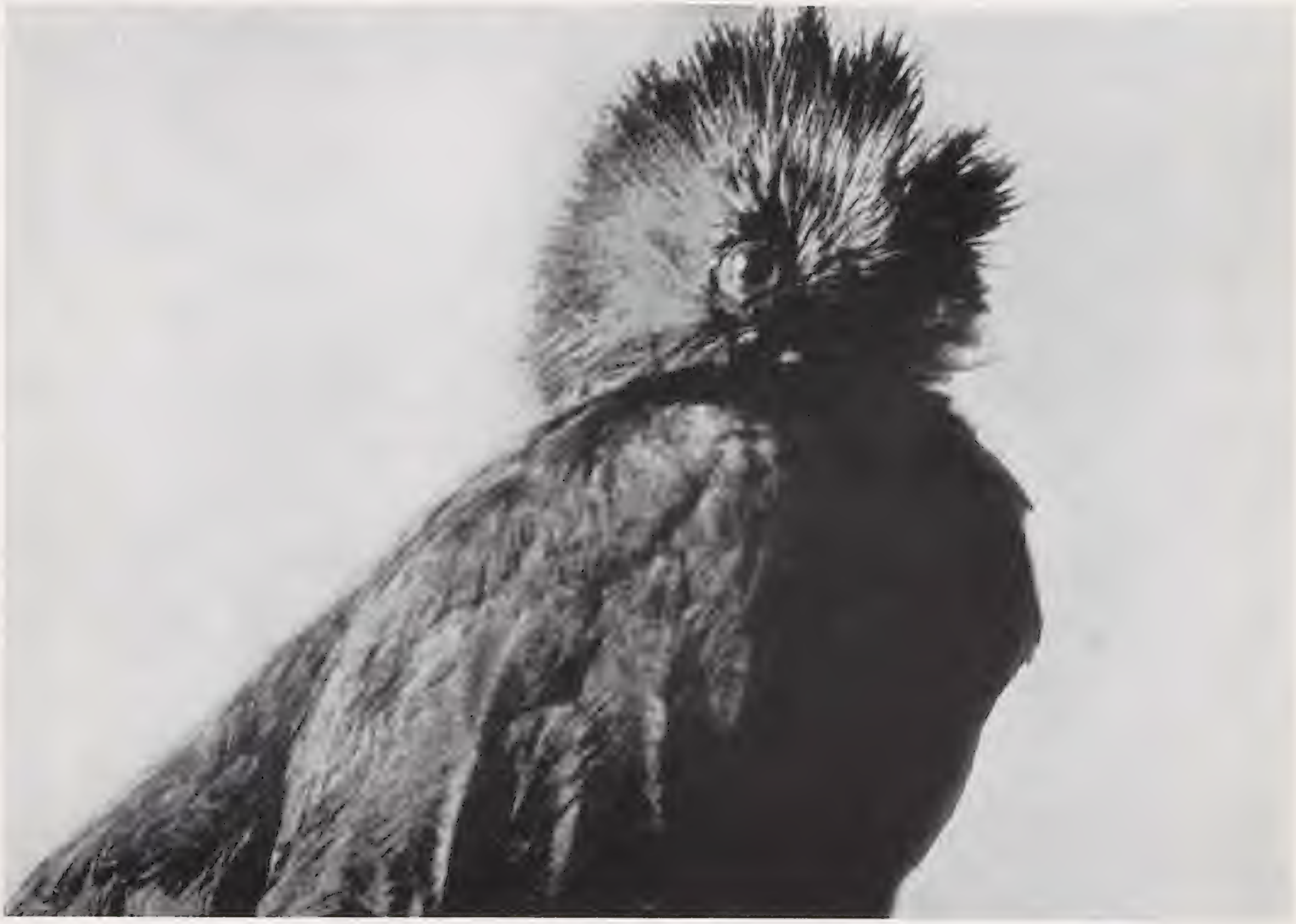
The discovery of that ancient tree with its tell-tale nesthole gave us the clew to the nesting habits of the Quetzal, and in subsequent days we located no less than nine other nests. Near most of them we raised observation platforms, or at least rigged bush ladders by which we could reach the nest when it came time to remove the young birds.

These daily observations and the monotonous waiting for the nestlings to attain such a size that it would be safe to remove them, went on for weeks and finally came a time when I saw one young bird, his body only sparsely speckled with the brilliant feathers that will eventually cover it completely, pop up to the edge of the nest hole and look around on the world for the first time. It was the moment of the trial flight, the first essay into the world, and entranced I watched as he craned this way and that, judging the distance to the nearest limb, perhaps making up his mind exactly how far he dare attempt to trust himself on his new wings.

At last he launched himself toward a nearby branch. I watched with more excitement, perhaps, than the bird felt. He came just short of the mark; an inch or two higher and he would have landed squarely. But the distance was accurate enough to permit him to catch the limb by his neck, and then, half hooked on, he flut-



By the time the Quetzals were about five weeks old, they were quite tame and would perch calmly while they were inspected and fed. As a necessary precaution, one wing was clipped, however. Here Mrs. von Hagen is shown with five of the nine young birds that eventually were collected for shipment to New York.



The adult, male Quetzal is a bird of magnificently colored plumage, his head surmounted by a crest of bright, metallic green. The young male in the Zoological Park's collection is beginning to show a crest, although it will probably be many months before he reaches adult plumage.

tered and scrambled and at last reached safety and a secure perch. The bird and I both breathed more freely after that.

That trial flight was an unmistakable intimation that it was time to remove the young birds. At night, when the females were on the nest, we made the rounds of the holes we had been watching and took out the young and the mothers. The young birds I felt fairly confident that I could accustom to civilization. The older birds were an experiment, and one that did not succeed. By preliminary work in the United States I had had a preparation of nembutal, a soporific drug, prepared in dilute doses, and this was injected into the adult birds to facilitate their removal to the lower camp. Otherwise, with full possession of their powers, they would have harmed themselves and made transportation difficult. The nestlings gave us no trouble at all, and the drug was not necessary.

The injections made it possible to transport the adults to the base camp, but it soon became apparent that they could not withstand confinement, and consequently they were turned loose.

In the base camp the young birds were given a fair amount of liberty after their wings were clipped, and they soon became so tame that any lingering fears about transportation to New York disappeared. All we had observed in the bush about their habits, the trees on which they fed, their liking for insects, and so on, came into practical use. While at that juvenile stage they had to be hand-fed, the pulp of cultivated avocadoes was easily obtained and easily administered. They grew noticeably even while we were in the base camp. When our work in that region was finished, the return trip to the seacoast began and happily resulted in no fatalities in our little aviary, although the hardship to the birds, accustomed to the cool air of the peaks, when going through the torrid lowlands, must have been great.

At last, after four months of labor and discomfort, the birds were placed on shipboard, in care of a faithful seaman, and our part of the quest was at an end.

Further work in the interior was calling me insistently, but I waited at the seaport until the day when the ship docked in New York. The cable I wanted—expected—came at last, from the Curator of Birds at the Park:

"NINE QUETZALS ARRIVED ALIVE."

The journey down to the seaport from the high, cool rain forest was a difficult period for the young birds, since they encountered sweltering heat that never comes to their home area.

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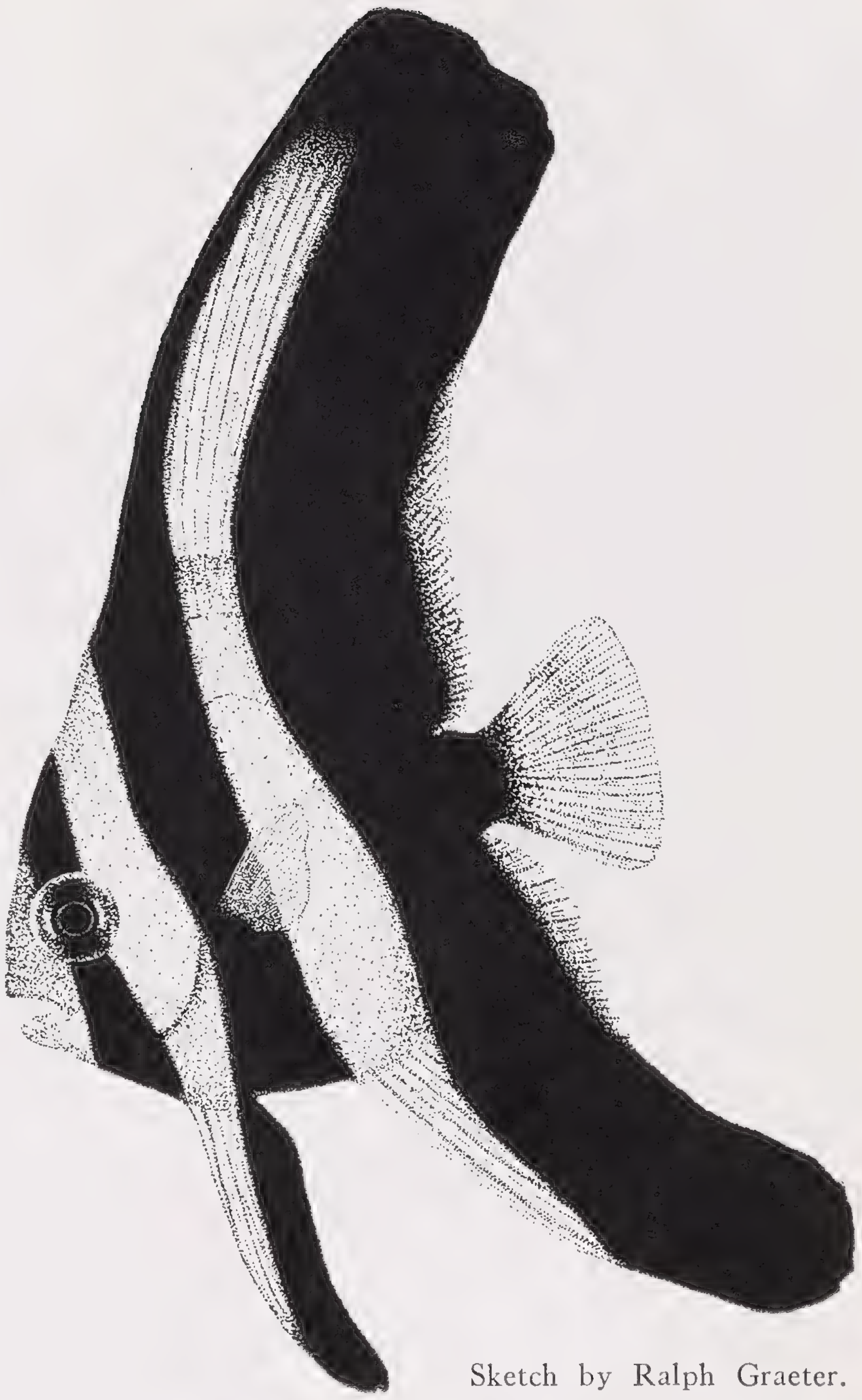
NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

Sea-bat at the Aquarium

The Aquarium is exhibiting its first sea-bat, *Platax teira*, a remarkably shaped and strikingly colored relative of the angelfishes. The fish arrived on September 15 of last year as a gift from the Hamburg Aquarium. An excessive elongation of the dorsal and anal fins and a lateral compression of the body gives the creature a superficially triangular appearance, and to one unacquainted with the vagaries of fishes' body-forms it seems just a bit unreal when viewed for the first time.

Our specimen is still a youngster, as evinced by its continued rapid growth. Now about five inches long, it may reach over twenty, for sea-bats of that size have been caught in their native waters. These are, incidentally, quite extensive, stretching from the east coast of Africa throughout the East Indian seas and beyond. Not only has our fish grown, but it has changed shape to a marked degree. About one month after its arrival its total length (from snout to tip of tail) was a little more than three-quarters of its greatest depth (from tip of dorsal to tip of anal fin). Two months later it was almost twice as deep as it was long. The accompanying sketch was made at this time.

Still another decisive change is to be expected: as the sea-bat increases in size it will lose its stripes and become more or less uniform in color. Because of the great differences between young and adult, this fish was originally described under several scientific names. Another complication was introduced in that preserved specimens—from which scientific descriptions are most often made—usually fail to keep all but traces of their dark vertical bars and become rather uniformly pale. Thus, most illustrations of the sea-bat do not show these stripes.—J. W. A.



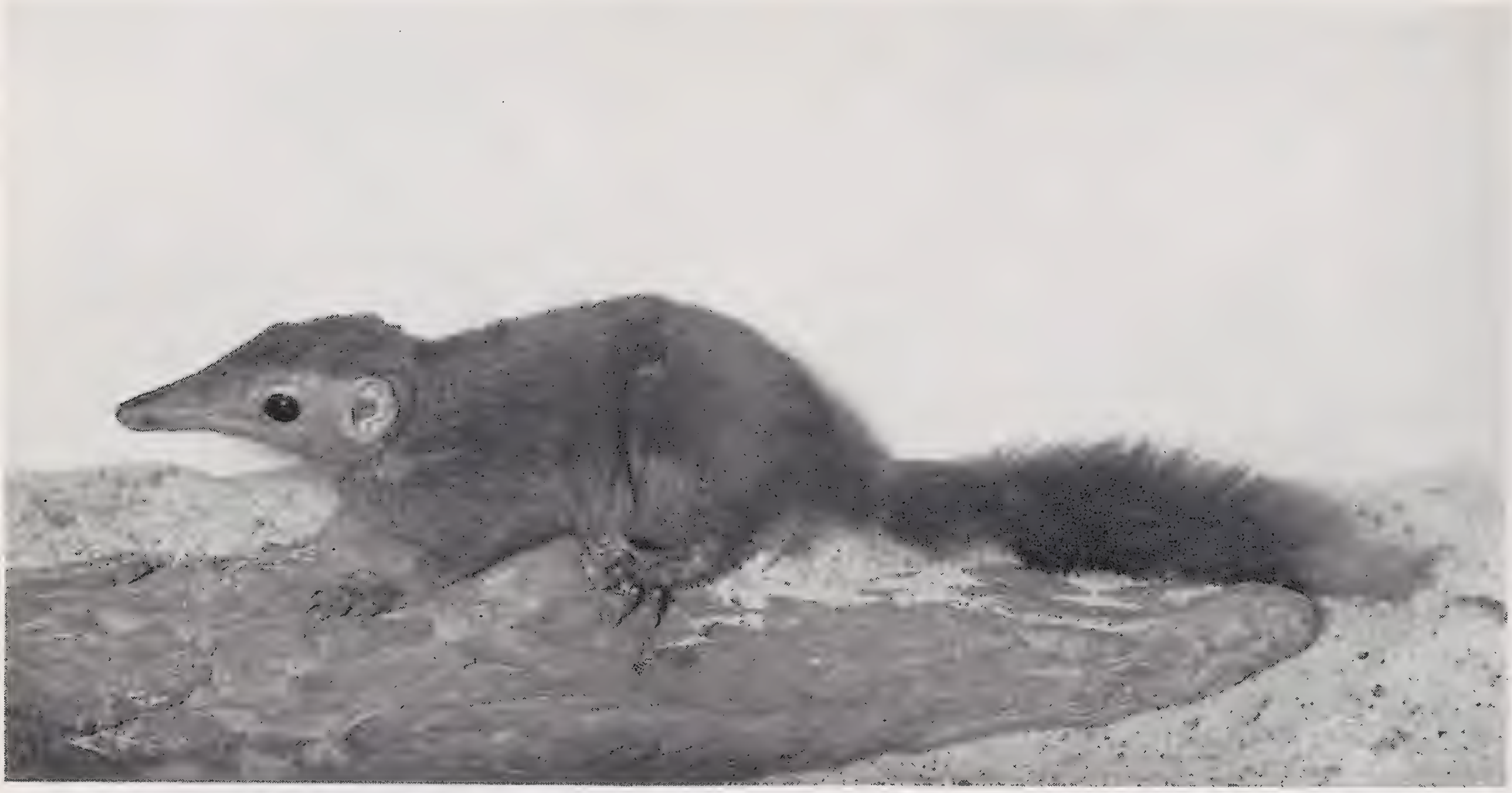
Sketch by Ralph Graeter.

Dark bands of deep brown and black alternating with lighter ones of silvery gray make the Sea-bat quite conspicuous and accentuate its queer shape.

The Malayan Tree Shrew

One of the last mammals to be received at the Zoological Park during the past year was the rare tree shrew (*Tupaia ferruginea*) from northern Sumatra. We have always been on the lookout for one of these interesting little animals but this is the first instance of its being offered on the New York animal market. It is extremely rare in captivity and while a few specimens have been exhibited in Europe it has reached America on only one previous occasion.

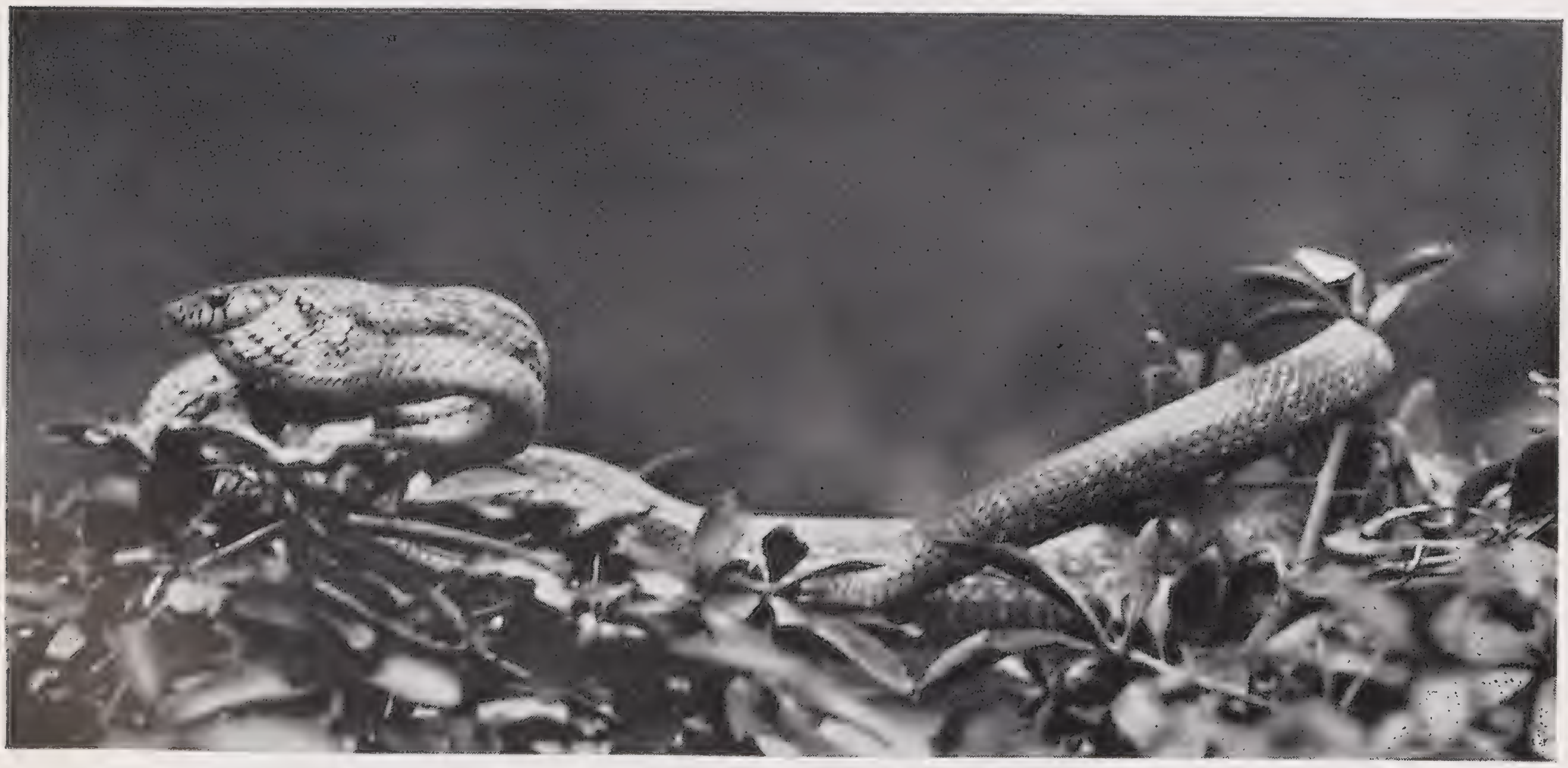
Zoologically, the tree shrews (Tupaidae) constitute a family of arboreal insectivorous mammals found only in the Indian and Malay region of southeastern Asia. They differ from all other present-day Insectivora in two respects: they are arboreal, as their name implies, and they are diurnal in habits. They bear a remarkably close resemblance to squirrels and the casual observer would believe them to belong to that group. Closer inspection reveals the long, shrew-like nose and the entirely different type of dentition. However, the general resemblance to squirrels is so remarkable that tree shrews have long been pointed out as an example of parallel evolution. Also, this resemblance has been noted as a possible case of mimicry, with some benefit from the likeness accruing to the tree shrew. Just what this might be we can not say.



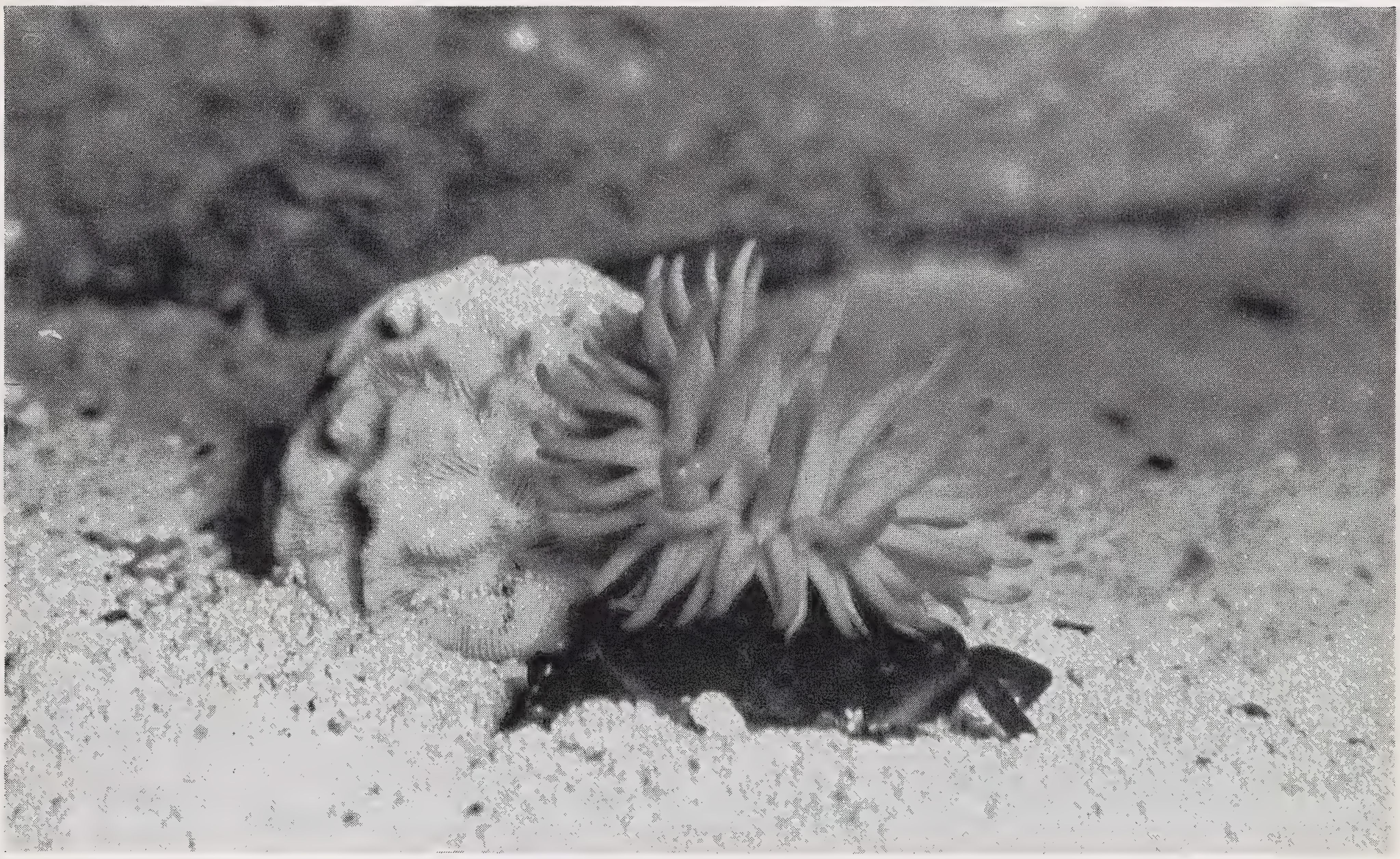
The Malayan tree shrew belongs to a family of arboreal insectivorous mammals found only in the Indian and Malay region of southeastern Asia. Man is supposed to have evolved from a tree-dwelling insectivore. The animal bears a general resemblance to our familiar squirrels.

In a wild state tree shrews occur in wooded regions where, like squirrels, they are found in and about trees or on the ground. Like our true shrews (Soricidae) they have the reputation of being quarrelsome and unsocial. On the other hand, "they are easily tamed, and become at times, of their own accord, very familiar, entering houses, climbing on tables and beds, and helping themselves to any food they may fancy." One is mentioned that acquired a taste for tea and coffee.

Our specimen ate his food, consisting of bits of fruit, insects and the meat of small birds, while sitting upright like a squirrel and holding the food with his fore-feet. After eating he usually indulged in a nap, curled up in a corner of the cage. He was tame and could be stroked with the hand, perhaps without any particular enjoyment



A Brazilian Blowing Snake was a recent accession in the Reptile House. The snake has the power of expanding the whole forward part of its body—a type of defense found among snakes in several parts of the world. In this picture the snake's neck has started to expand.



An anemone takes up a gipsy's life—on the back of an active and agile rock crab. Ordinarily the anemone would remain attached to the wall of its tank, or move slowly in search of food. This one probably fell upon the back of the crab, liked its mobile home, and attached itself.

on his part. But he at least evidenced no open objection to such familiarity.

We had hoped to keep this rare animal for some time and make a further study of its habits in captivity but it died after being on exhibition for a week. There was no apparent cause of death but it is not too far-fetched to believe that its nervous temperament was incompatible with the ever-moving stream of visitors that passed its cage.

Thus occurred the final chapter in the life of a peculiarly interesting little animal. As mentioned above, it is the only present-day arboreal insectivor. Man is supposed to have evolved from a tree-dwelling insectivorous mammal. The connection is obvious. Perhaps in the tree shrew we can see our own prehistoric selves.—C. W. L.

"Two-headed Fishes"

The arrival in New York of a commercial shipment of fifty or a hundred thousand living fishes every week or so has made us somewhat blasé about the claims of the collectors who bring the fishes in, but we were astonished in December to hear from a collector just back from Brazil that he had a number of fishes that had two heads and two mouths. They were, he said, something like an eel, but because they twisted about so much and had two mouths which might bite him, he had not examined them closely! Would we please come over and look at them? We would, and did, immediately, and were a little startled to find that the two-headed fish were not fish at all, but coecilians, or limbless amphibians. Our ichthyological chagrin that they were not fish was tempered, however, by the reflection that coecilians are exceedingly rare in collections of animals of any sort, for it is all but impossible to catch them.

We have been unable to learn the point of origin of these creatures, for the collector started with some of his animals at that point on the Amazon touched by Colombia, Peru and Brazil, and added to the collection as he came down stream. Just where he acquired the coecilians did not seem particularly important to him, so he forgot about it.

He thought, however, that they were entirely aquatic, since he had kept them in a can of water, and he knew that they liked to burrow into sand at the bottom of the collecting can and would eat bits of fish. Further than that he knew nothing except that he would like to sell his queer "eels."

The idea that he had a fish with a head at either end originated in the curious physical appearance of some of these coecilians. In the genus *Typhlonectes,* to which the present animals belong, the head is comparatively small and tapered, while the posterior end is wide and is equipped with a sort of adhesive disk which may be folded together to be more or less invisible, or opened to expose the vent in the center.

The specimens exhibited at the Aquarium are about eighteen inches long, half an inch or so in diameter, and equipped with a dorsal ridge which runs from behind the head to the extremity of the body. They have only the merest indication of a tail.

They can swim either forward or backward by undulating the body in the manner of an eel, but are usually seen on the floor of the tank, where they crawl along much as a snake would. They seem to be able to make equally good progress either head or tail first, but when they burrow into the sand, they invariably do so head first. The head of all the coecilians is pointed, slender, and heavily boned for burrowing.

The animals have not been in the Aquarium long enough for us to make more than casual observations of their behavior, but they seem thoroughly at home in their tank. They do not fit into the available taxonomic keys given for their identification, as far as we have been able to examine them in life, and thus for positive identification as to species we will have to wait until one of them dies.—C. W. C.

Master of the Feed Room

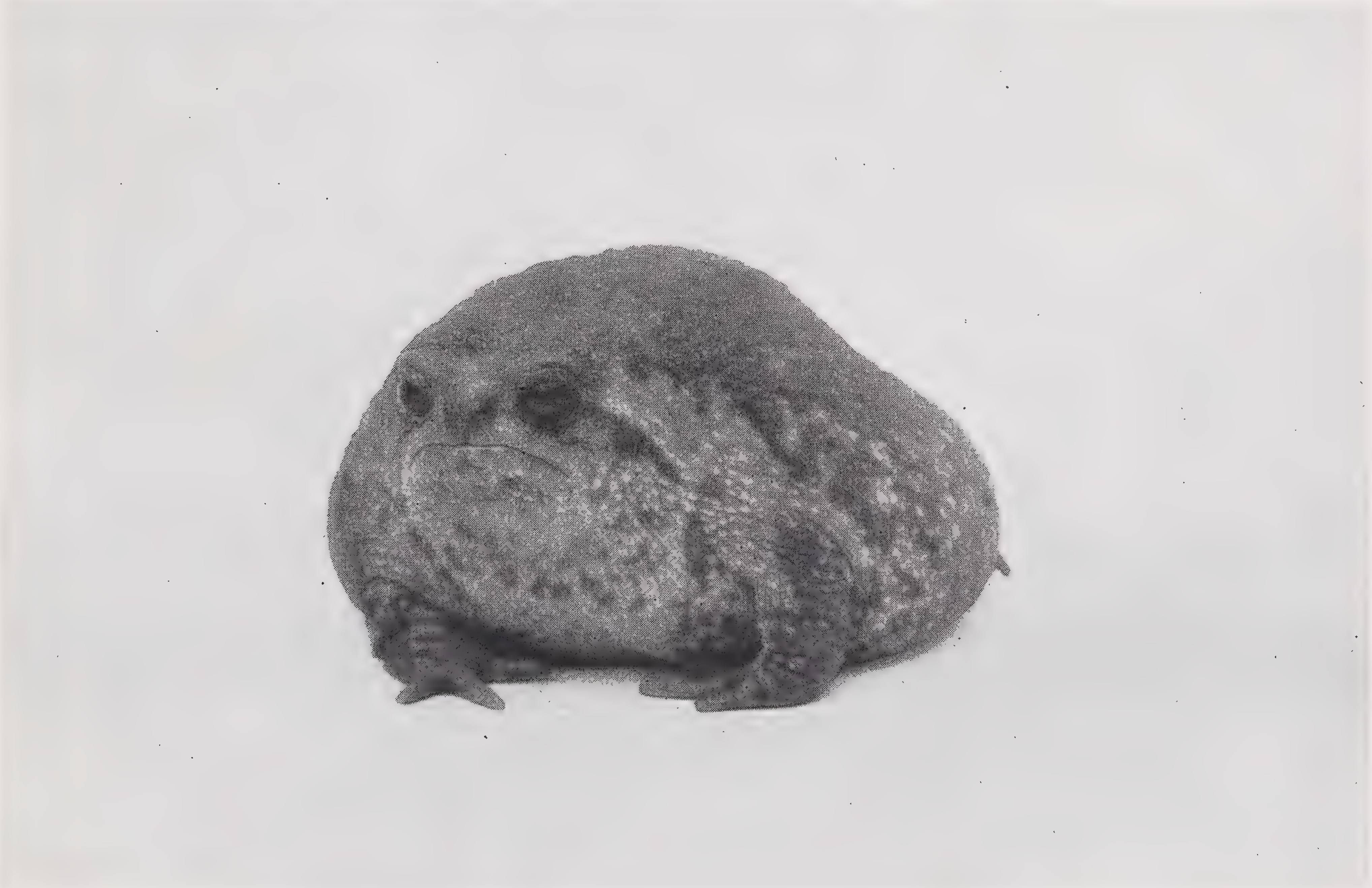
"Haile," a South African wood owl, is rapidly becoming master of the feed room of the Bird House in the Zoological Park. The feed room was a mere temporary cage when the owl arrived from Africa almost two years ago as a very immature specimen, but since then it has developed such a strong personality — and such engaging tricks, such as pouncing on the head of an occasional visitor — that it probably will stay there permanently.

The owl, *Surnium woodfordi*, was sent to the Park by Dr. A. K. Haagner, who maintains a small zoological collection at Beira, Portuguese East Africa. On one of his visits to Beira, A. M. Vida, radio operator of the *City of New York*, was given the bird by Dr. Haagner with a request that he turn it over to Curator Crandall.

Haile—so named by his keeper in the Bird House—was of quite doubtful identification for the first few months. His plumage was hardly more than fluffy down and there were few characteristics by which he could be assigned to a particular species. With developing adult character, however, Mr. Crandall discovered that the newcomer was of some importance, for no specimen of *Surnium woodfordi* had previously been exhibited here.

In the process of learning his way around the domain of the feed room, Haile underwent several periods of extreme tribulation. Once he alighted on a hot stove that had just been used to prepare part of the Bird House menu. On another occasion he attempted to perch atop the cage of an ancient macaw, and the macaw almost bit the owl's toe off.

Bathing is the owl's chief pleasure and recreation. In the regular routine of the building, the keepers each morning wash out the feed pans under a tap of running water. When an especially large pan has been filled with water, Haile almost invariably shoots down from some high perch around the room and appropriates the pan for his morning bath. During the subsequent splashing and fluttering, the washing of other pans has to halt.



The Potato Frog, Breviceps gibbosus, *is one of the most unusual frogs that have been added to the Park's collection. A burrower, possessed of short but stout legs, and able to move in a slow walk, its appearance is well described by its name. It is from South Africa.*

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NEW YORK ZOOLOGICAL SOCIETY

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

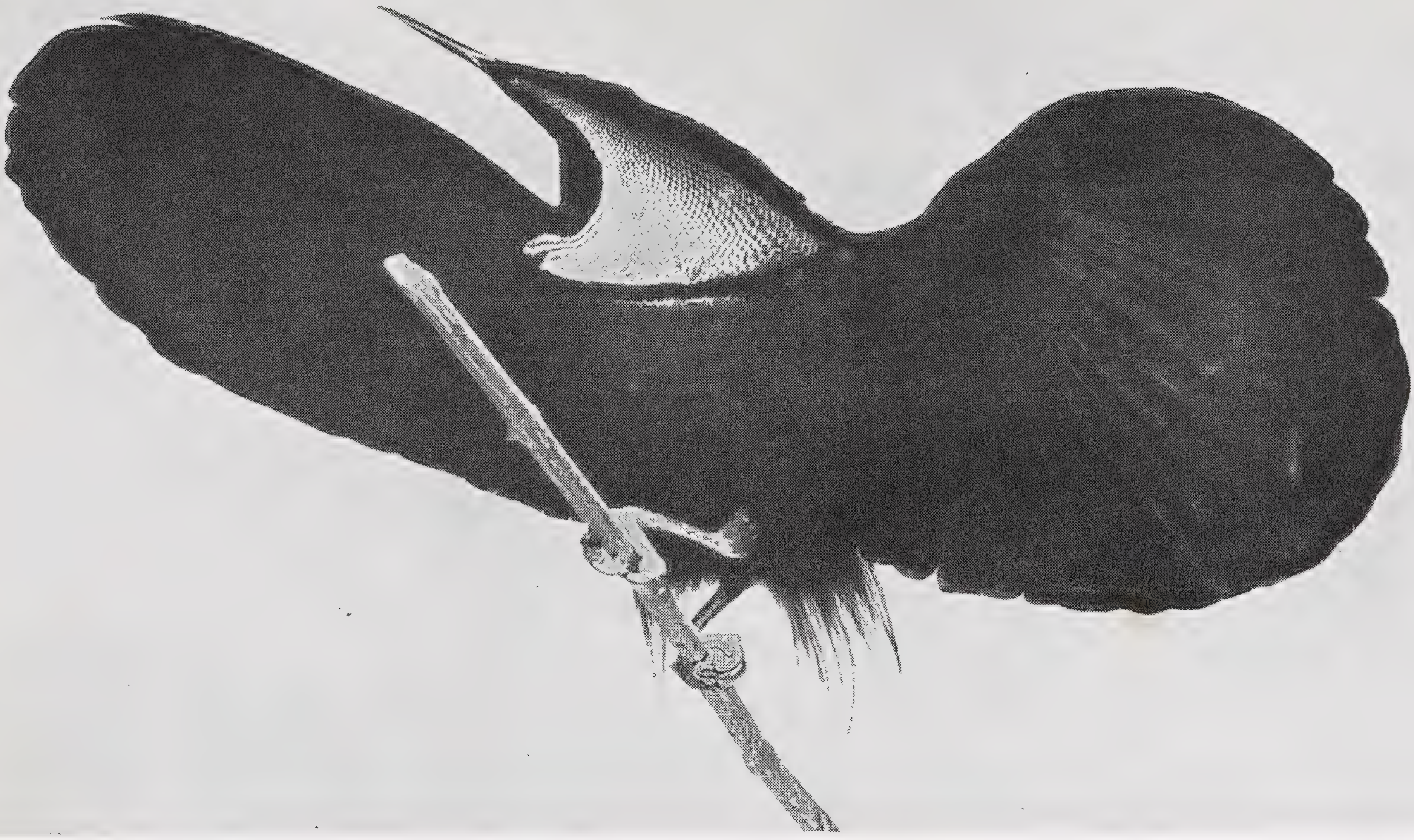
Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

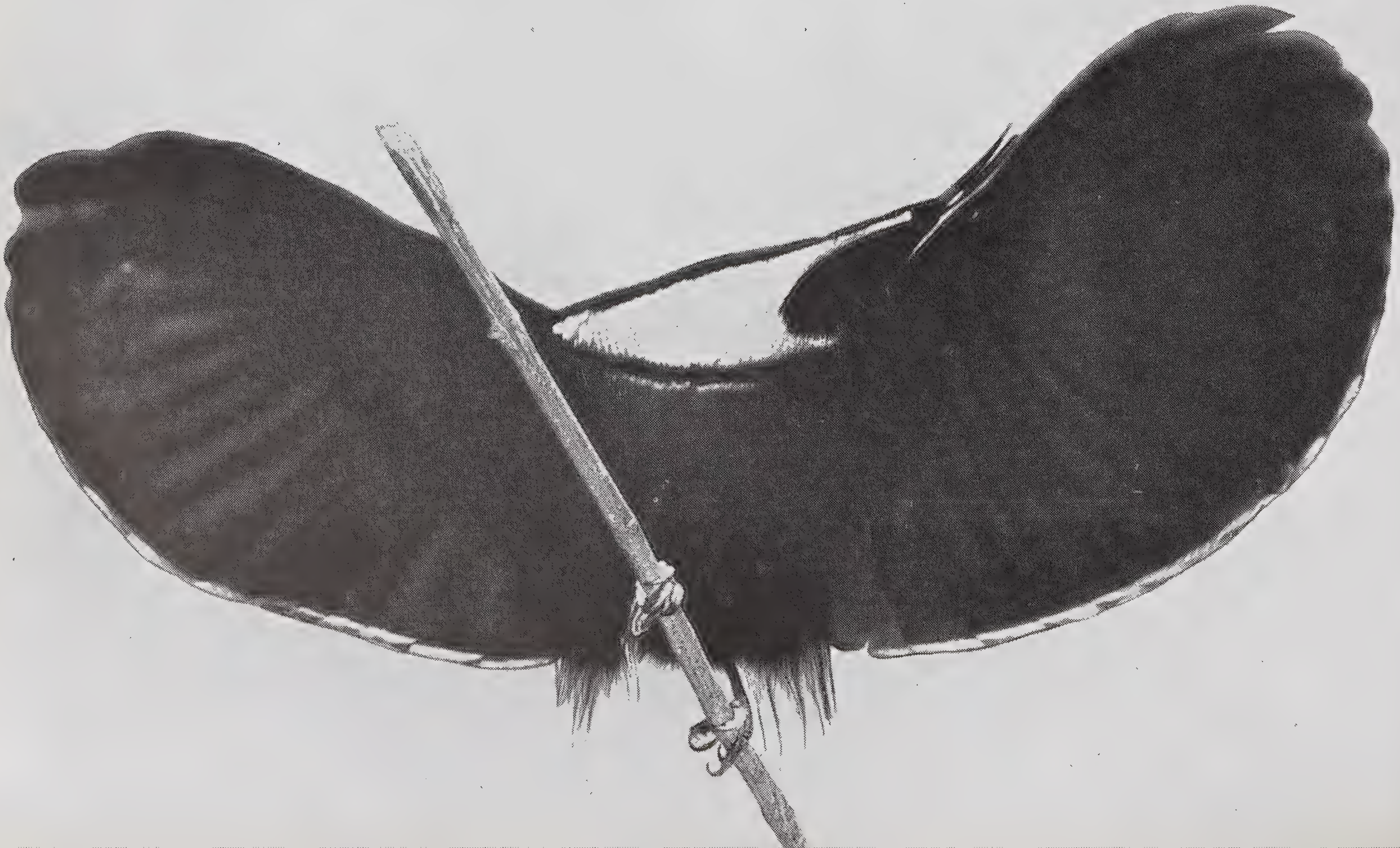
Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



DISPLAY POSTURES OF THE MAGNIFICENT RIFLE BIRD



BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

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Vol. XLI March-April, 1938 No. 2

Display of the Magnificent Rifle Bird

The Spectacular Performances of the Birds of Paradise Reach a Climax in the Dazzling Posture of This Species

Lee S. Crandall

THE display postures of the birds of paradise have furnished a high light in our collections for many years. Beginning with Prince Rudolph's Blue Bird of Paradise, in 1921, we have been able to exhibit and observe a continuous series of unusual species, including the Long-tailed, the Emperor of Germany's and Lord Rothschild's Gorgetted, as well as many others more commonly seen, although not always better known. Spectacular though the performances of all of these birds may be, we feel that a climax has been reached in that of the Magnificent Rifle Bird (*Craspedophora magnifica intercedens*) of southeastern New Guinea. A description of this display has already appeared in *Zoologica*[1] but as photographs have since been obtained by Mr. Osterndorff, an opportunity is presented to make the bird better known to our members.

At first glance, the rifle bird is not impressive. His plumage is chiefly dull black and there are no brilliantly colored flank plumes to relieve the sombre effect. Closer inspection, however, develops a different picture. The body feathers are found to be soft and dense, with a texture that even the finest velvet cannot equal. Short, filmy, black plumes extend just beyond the end of the tail. On the breast is a brilliant, flashing triangle of iridescent bluish-green, its base spreading across the chest, its slender apex extending nearly to the chin. The crown and the upper surface of the tail are similarly ornamented, although these decorations are not easily seen.

Received in October, 1936, through M. Jean Delacour, our rifle bird showed no signs of unusual activity for nearly a year. Then, in the autumn of 1937, occasional glimpses of the remarkable display were had but nothing definite could be observed. It was not until Dr. Leister was inspired to borrow a mounted female from the American Museum of Natural History that the full performance was seen. With the immobile female attached outside the wire of his cage, the male displayed repeatedly, so that complete notes, accurate drawings and finally photographs, were made.

Selecting a branch running at an angle of about 45°, the bird faces the front of the cage and begins a leisurely preening of the plumage. The feathers at the sides of the breast are extended outward, finally merging with the short flank plumes, which encircle the lower part of the body. Then, without further warning, the wings are suddenly opened widely, accompanied by a distinct "plop," apparently caused by friction of the feathers. The head is extended and thrown to one side, so much so that it may almost entirely disappear behind the wing. Then begins a series of rapid movements, so dazzling in their effect that details are not easily observed. The bird rises slightly, somewhat relaxing the wings.

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[1] Crandall & Leister, Zoologica, Vol. XXII (Part 4), December 31, 1937).

APR 6 1938

The head is then moved swiftly to the other side, its arrival accompanied by a "plop," as the body is lowered and the wings again fully extended. This maneuver may be repeated as many as thirty-five times but the rhythmic movements of the scintillating breast plate hold the observer so fascinated that first counts may not be accurate.

In the Days of "Buffalo Bill" Cody

Many Hunters of the Bison Won the Same Title by Their Skill when the Great Herds Still Roamed the West

MARTIN S. GARRETSON

[*This article is a chapter from* "The American Bison," *a book by Mr. Garretson, Secretary of the American Bison Society and Curator of the National Museum of Heads and Horns, which the New York Zoological Society will publish early in April*].

IN the days when railroads and settlements were advancing across the great plains of the West, the country was a wild, uninhabited region, except for Indians and countless numbers of wild animals, all of which were destined to be swept aside or exterminated in an almost unbelievably short space of time. In accomplishing this, many Indian fighters and buffalo hunters acquired sufficient notoriety for certain outstanding individual efforts to be remembered, and their names and deeds are recorded in the history of the settlement of that country.

At that time, such men were often better known and identified by names other than those given when baptized. This title, which a man assumed or had applied to him for some special accomplishment or superability in the performance of one certain thing, usually became the only name he was known by, or it was used as a prefix to his surname. Consequently, among the buffalo hunters there were dozens of "Buffalo Bills," each contending that he, and he alone, was the only original Buffalo Bill and that all others who had assumed the title were impostors and had no right to it. However, there were two whose records have survived, and the interesting fact is that both of these buffalo hunters obtained the title of Buffalo Bill for entirely different reasons. While the fame of one never spread to any extent outside of his home state, the other, through his activities, became a well-known character throughout the civilized world.

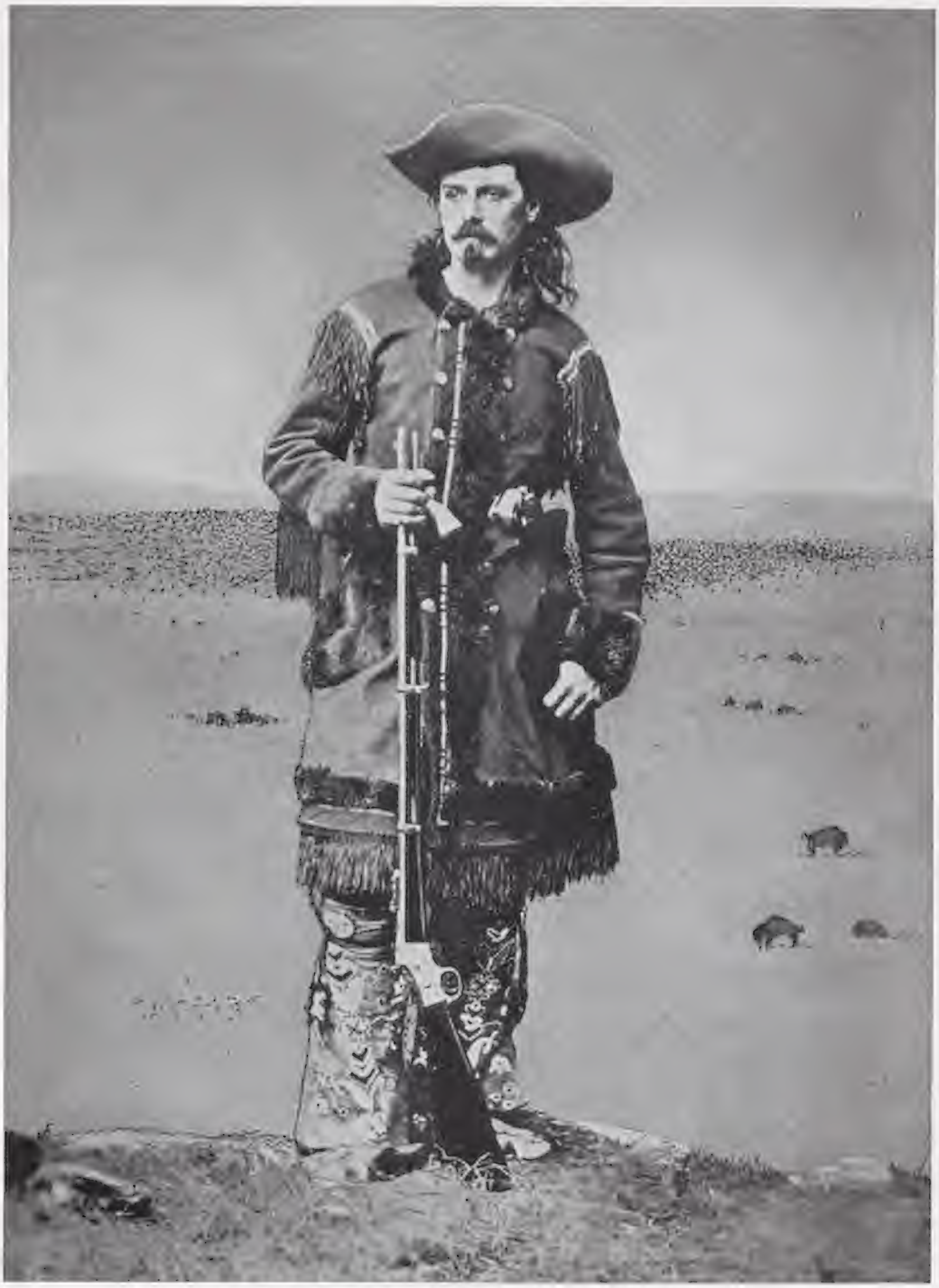
The former was a noted frontiersman, scout and Indian trader during the 'Fifties and 'Sixties, by the name of William Matthewson, and was among the first to acquire the title of Buffalo Bill.

In 1860 there was a terrible drought in Kansas, the crops having failed entirely, and the settlers were facing starvation. There were plenty of buffalo roaming the plains, but the Indians were numerous and hostile and the settlers were unused to Indian warfare. It was then that Matthewson took some men and a wagon train out to the buffalo grounds and from September until February killed great numbers of buffalo and sent train after train of meat to the famine-stricken people of western Kansas. From that time on he was familiarly known as Buffalo Bill by the grateful settlers.

Being a quiet, unassuming man, Matthewson never sought to acquire publicity under the title given him by the settlers.

In 1865 he pre-empted the quarter section of land on which the town of Wichita now stands and built on it one of the first houses—a log house—which stood for a long time on the banks of Chisholm Creek. Matthewson was a public-spirited citizen, became wealthy and built himself a fine residence on Central Avenue, where he lived the remainder of his life.

In 1867, when the western end of the Kansas Pacific Railroad had reached the heart of the buffalo country, the Indians were very troublesome and it was difficult to obtain meat for the large number of construction hands. The company therefore decided to employ expert hunters to kill buffalo. They required about twelve



From *The American Bison*

When Buffalo Bill Cody posed for this photograph in the early 'Seventies, the photographer placed him in front of a screen depicting palms and a sailboat. A later retoucher gave him a more appropriate background of bison.

buffalo a day, twenty-four hams and twelve humps, as only the hump and hind quarters of each animal were utilized. As the Indians were riding all over that section of the country, the work was exceedingly dangerous and the duties required a journey of five to ten miles from the railroad every day to secure the game. William F. Cody accepted the position and demanded a salary of $500 a month, which the company could well afford to pay as the meat itself would cost nothing.

The outfit consisted of Cody, his celebrated buffalo horse "Brigham," and his favorite rifle, "Lucretia Borgia." He was accompanied by only one man, with a light wagon drawn by a team of mules to haul the meat back to camp.

It was not long before he acquired a considerable reputation as a buffalo hunter, and it was at this time that the title of Buffalo Bill was conferred upon him by the railroad hands.

During his engagement as a hunter for the company, which covered a period of eighteen months, he killed 4,280 buffalo and had many exciting and hair-breadth escapes from the Indians.

While Cody was employed by the railroad to furnish meat for the construction hands the Army officers at Fort Hays arranged for a buffalo-killing contest in which Cody was matched against Billy Comstock, a famous scout and hunter employed at Fort Wallace. The officers at Fort Wallace thought Comstock had more right to the title of Buffalo Bill, and raised a purse of $500.

Posters were put up at the stations along the new railroad and an excursion train was run from St. Louis, carrying more than one hundred passengers, including Cody's wife. The wording of the old poster is as follows:

Grand Excursion
To
Fort Sheridan
Kansas Pacific Railroad
Buffalo Shooting Match
For
$500. A Side
And the
Championship Of The World
Between
Billy Comstock (the famous scout)
And
W. F. Cody (Buffalo Bill)
Famous Buffalo Killer
for the
Kansas Pacific Railroad

Twenty miles east of Sheridan the buffalo were plentiful and the prairies level enough so that all could see the chase. At this point the party left the train and rode to the hunting ground in wagons and on horseback. Cody rode Brigham and used his needle-gun, a breech-loading Springfield rifle, caliber 50. Comstock used a Henry rifle.

The wager was $500 a side, and the man who killed the greatest number of buffalo from horseback in one day of eight hours, beginning at 8 o'clock in the morning, was to be declared the winner.

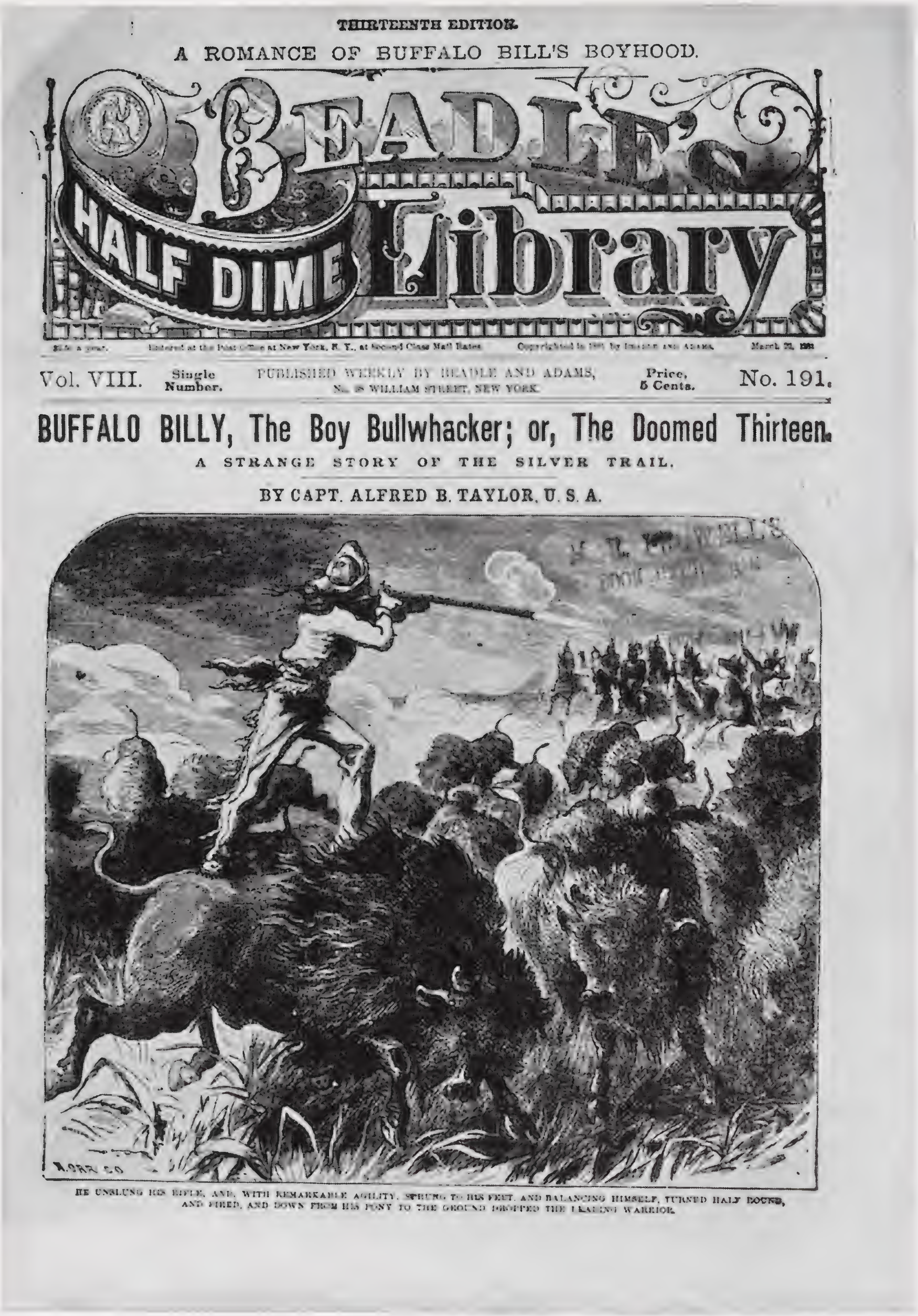
A referee was to follow each hunter to count his buffalo. Both hunters were to enter the herd at the same time.

Three runs were made. In the first, Cody killed thirty-eight, and Comstock twenty-three. In the second, against a herd which was composed mostly of cows and calves, Cody killed eighteen, and Comstock fourteen. In the third and last run Cody gave an exhibition of his skill and horsemanship by leaving both saddle and bridle behind; he entered the herd and quickly killed thirteen, Comstock, nine.

This finished the contest with a total of sixty-nine for Cody and forty-six for Comstock. Cody was then declared by the referee to be the champion buffalo hunter of the plains, and to have proved his right to the title of "Buffalo Bill."

On their return to camp they brought along all the largest buffalo heads, which were turned over to the railroad company. Cody had been instructed, while filling his meat contract, to save all the finest heads. These were mounted and sent to the principal cities along the road, as well as to the railroad centers of the country, where they were prominently displayed in the leading hotels and in the stations as an excellent advertisement for the road. Today an occasional old, moth-eaten head is pointed out as being one of those obtained by Buffalo Bill while killing buffalo for the railroad.

Cody's meat contract with the railroad and his successful contest with Comstock brought him notoriety as well as the title of Buffalo Bill. However, a number of other Buffalo Bills, who no doubt were great hunters, never sought to establish or advertise their prowess. But Cody's ambition and opportunities were greater. Being in the employ of the Army as chief scout at Fort McPherson, Nebraska, he was quite frequently engaged as scout and guide for many of the famous buffalo parties. James Gordon Bennett of the New York *Herald,* who was a member of one of these hunting parties, invited Cody to visit him in New York. Cody accepted and was thus largely advertised in the East. Shortly after that he appeared on the stage as an actor in western dramas, but the event which firmly and forever established his title of "Buffalo Bill" was the creation of the famous "Wild West" show which he exhibited for many years



THIRTEENTH EDITION.

A ROMANCE OF BUFFALO BILL'S BOYHOOD.

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BUFFALO BILLY, The Boy Bullwhacker; or, The Doomed Thirteen.

A STRANGE STORY OF THE SILVER TRAIL.

BY CAPT. ALFRED B. TAYLOR, U. S. A.

HE UNSLUNG HIS RIFLE, AND, WITH REMARKABLE AGILITY, SPRUNG TO HIS FEET, AND BALANCING HIMSELF, TURNED HALF ROUND, AND FIRED, AND DOWN FROM HIS PONY TO THE GROUND DROPPED THE LEADING WARRIOR.

From *The American Bison*

Such publications as this, professing to recount the life and adventures of Buffalo Bill, made Cody's name a household word in the 'Eighties.

in all the principal cities of North America and foreign countries.

It is of interest to note that this show was the outcome of a Fourth-of-July celebration on Ike Dillon's ranch at North Platte, Nebraska, in 1882. One feature of this show was a buffalo hunt, but this could not be literally carried out, as all the wild buffalo had been killed. However, one of the leading citizens, Mr. Merrill C. Keetin, had a small herd of semi-domesticated buffalo near North Platte and these were loaned for the exhibition, which was a huge success and lasted three days.

In starting the Wild West show, Cody bought some of these buffalo from Mr. Keetin and it is a peculiar fact that Cody never captured any buffalo nor established a herd of his own; all the buffalo he ever owned and used for show purposes, he bought wherever he could find any for sale. In 1886 Cody purchased from the Philadelphia Zoological Garden an adult bull and cow for $300. The bull was an exceptionally fine animal, but unfortunately his neck was broken after being roped in the enclosure. Some years later Cody purchased seven buffalo from Col. Charles Goodnight for $225 a head.

Cody killed his last buffalo on December 14, 1910, on the ranch of Major Gordon W. Lillie, "Pawnee Bill," near Pawnee, Oklahoma. This was for a barbecue feast given in honor of Cody and a party of friends from the east. The buffalo was an old bull and Cody killed it with one shot.

Cody died at the home of his younger sister in Denver, Colorado, on January 10, 1917, and is interred on Lookout Mountain, fifteen miles west of Denver.

Buffalo Bill Cody has passed on, but his name remains as steadfast in the American legend as he was in his long and glamorous lifetime. The echoes of his activities have died away, but the name of Buffalo Bill will long endure in the history of the settlement of the trans-Missouri plains.

* * *

As emigration proceeded westward, far in the forefront were the pioneer cattlemen who established ranches on the great buffalo range, at that time still covered with countless numbers of these animals and other wild game.

Many losses and much trouble was frequently caused when the migrating buffalo became mixed with the cattle. Often the cattle were swept along in a wild stampede and at other times would follow the buffalo and in this manner travel many miles from the home range. Unless followed and brought back, they would soon be irretrievably lost, and usually became as wild or wilder than the buffalo.

Shortly after the Indians had been driven out of the Panhandle of Texas, Col. Goodnight decided to establish a cattle ranch in the Palo Duro Canyon. Goodnight had formerly been a member of old Sul Ross's Frontier Rangers in the 'Sixties and had ridden all over the Panhandle.

The Palo Duro Canyon, rich in verdure and natural protection from the high winds of the plains, had been for uncounted ages the winter home of the buffalo and Comanche Indians. It was one to twelve miles in width and seventy miles long—a place where grass grew and water ran the year around. Goodnight, taking notice of these natural advantages, decided it was the ideal place for a cattle ranch.

Trailing his herd of cattle from Colorado, Goodnight entered the Palo Duro Canyon in November of 1876 to establish the famous J A Ranch. He entered the canyon by way of the old Comanche trail between Canyon Cite and the main Palo Duro Canyon. It took him half a day to work the cattle down this narrow and rugged trail. He then took the wagon apart and carried it down, piece by piece, on the mules. The narrowness of the canyon at this place prevented any buffalo from being in there, but as the canyon widened the number of buffalo increased until, when they arrived at the upper end of the wide valley where the home ranch was to be established, they were driving ahead of them ten thousand buffalo. These buffalo were moved down the canyon some fifteen miles, to give room and grass for the nucleus herd of sixteen hundred cattle. There a herd line was established to keep the buffalo from mixing with the cattle, turning back every day a thousand to fifteen hundred buffalo. This line was kept up for about a year until the buffalo were all slaughtered by the hide hunters, and then the line was not necessary.

Just before the close of the Civil War, Texas cattlemen found a market in Kansas for their beeves, and the thousands of head of Texas cattle that had accumulated during the war were driven north, some of them to be shipped to the slaughter houses in the East, and others to stock the northern ranges. The old cattle trails running north passed through a country that was wild and uninhabited except for Indians and buffalo and other wild animals. Frequently on the drive great herds of buffalo were encountered, often mixing with and stampeding the cattle. Sometimes a small herd of three or four hundred buffalo would run through the herd while they were grazing.

An old-time cattleman relates that in the spring of 1871 he went up the trail from Gonzales, Texas, to Abilene, Kansas, with a herd of cattle belonging to Choats & Bennett. They went into the Chisholm Trail, about three miles below Red River Station, and as soon as they crossed the Red River all their stock seemed to go wild, especially their horses, although they did not come into contact with any buffalo until they reached a point between the Red Fork and the Salt Fork of the Arkansas River. Several herds lost heavily at that time by cattle and horses getting into the buffalo drifts, which at that time were northward. These buffalo were in countless numbers. The whole face of the earth seemed to be literally covered with them, all going in the same direction. The drovers were compelled to send men on ahead to keep them away and to prevent the stampeding of their herds. They finally had to stop the herds until the buffalo passed. Buffalo, horses, elk, deer, wolves, antelope and some cattle were all mixed together, and it took several hours, with the assistance of the drovers, for them to pass. He declared that there were more buffalo in that herd than he had ever before seen of any living thing.

Colonel Ike T. Prior, one of the great cattle kings of Texas and acknowledged to be one of the greatest among all the trail drivers who ever went up the trail with herds of cattle for the Kansas markets and for stocking the northern range country, in relating some of his experiences of those old days on the trails, tells of one encounter with the buffalo that particularly sticks in his memory. It was in 1875 when he was on the way to Colorado with a herd of 3,000 head of cattle.

The usual route after crossing the Red River out of Texas was to drive to Dodge City and then head west to Colorado, but the Colonel wanted to save time and decided to head west immediately after crossing the Red River. He was warned by buffalo hunters not to take that route as it would be a hazardous one to travel. However, no heed was given to the warning.

After a couple of days on the trail, one afternoon the Colonel noticed a cloud of dust some distance ahead of him and soon recognized it as being raised by an approaching herd of buffalo.

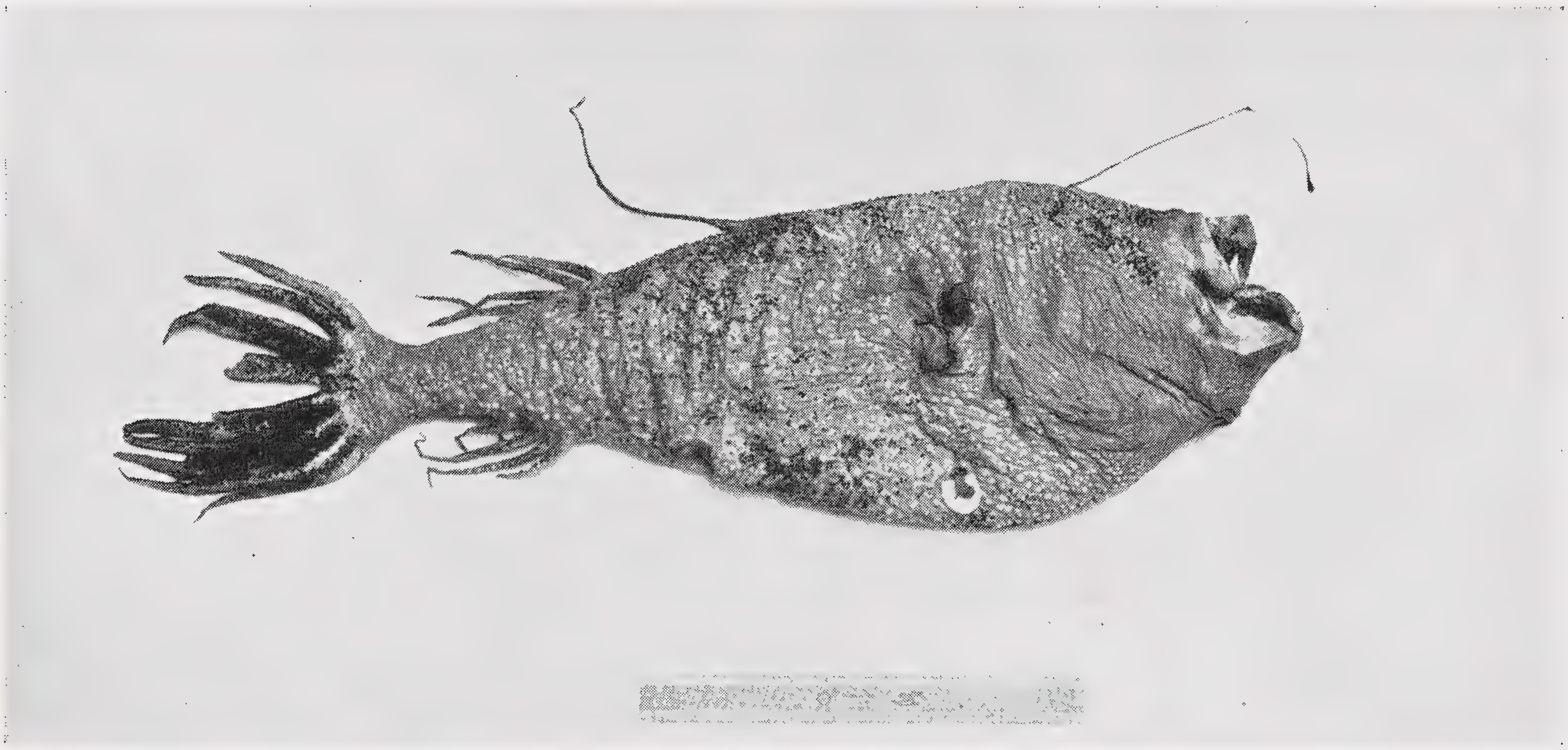
The cattle were hurriedly rounded up and left under the care of five men while the Colonel and seven men rode ahead about a quarter of a mile to meet the buffalo. When the front of the herd were in range the men started shooting into them, but instead of turning the herd to one side of the trail, the shots merely split it, sending the two sections around on each side of the cattle.

The outfit was soon completely surrounded by passing buffalo, which continued to move in that formation until the following morning. The herd was so vast that it was beyond the Colonel's ability to estimate the number it contained.

Fortunately, by close herding and ceaseless vigilance throughout the night, the cattle were held together and kept from joining the buffalo.

In 1868 the town of Abilene, Kansas, had become well established as a shipping point for the great droves of Texas cattle destined for eastern markets, and in order to advertise the fact and further to interest eastern buyers, it was decided to send east a carload of wild buffalo. A cattle car was strengthened by bolting planks on the inside to about three feet above the floor. Several expert ropers and their ponies were put aboard and the car was run out over the Kansas Pacific Railroad to the buffalo range and onto the siding at Fossil Creek, sixteen miles west of Abilene. Two of the men would rope a buffalo around the head and gradually work him toward the car. After getting him quite close to the railroad, a third rope would be cast around his hind legs and he was soon thrown and helpless, whereupon his legs were tied and he was drawn up over an incline into the car with block and tackle. In the car his head was securely tied to a post of the car frame.

Ten full-grown buffalo bulls were captured. Four of them died from the heat and excitement, three lay down and could not be gotten near the car, so three were all that could be brought to Abilene. A large canvas, painted in colors, advertising Abilene as the greatest Texas cattle shipping center, was hung on each side of the car. The car was sent to Chicago, via St. Louis, causing considerable newspaper comment. Upon its arrival at Chicago, the buffalo were turned loose upon the commons in the stockyards and a short time afterward they were killed and their skins presented to Prof. Gamgee, an English veterinary surgeon, who had them stuffed and sent to London.



The "Chandelier Fish" turned out to be Holboell's Angler, and this photograph shows the origin of its name. The parasitic male is outlined by the white tab at the lower side of the fish.

Ceratias—Siren of the Deep

Through Perpetual Darkness the Tiny Male Seeks Out His Mate and Attaches Himself to Her Spiny Skin for Life

William Beebe

SOME time ago my studio gong sounded softly and a boy handed me a telegram. "Do you want a chandelier fish," it said, and by the same messenger I telegraphed back "Yes." Any fish with a name like that is a Yesfish.

In due course it arrived and its history was unfolded. Mr. Devereux Barker, President of the Forty Fathom Fish Company of Boston, received word that a weird fish had been brought in by Captain Shea of the steam trawler *Ebb.* The fish shortly afterward disappeared and it took many hours of searching on the part of Mr. Barker and his friend Mr. Henry Palmer before it was relocated. Then Mr. Palmer's son, Vincent, who has been a member of several of the Society's Bermuda oceanographic expeditions, had it shipped to me on ice. So it is due to the interest and persistence of these three gentlemen that the department possesses one of the most amazing specimens ever received.

The photograph will show how it came to get its name. The fish was taken in a trawling net at a depth of one hundred fathoms, or six hundred feet, on June 28, 1936, on the northern edge of Georges Bank, east of Cape Cod. It is a deep-sea fish belonging to the group of sea-devils or anglers, and its name, *Ceratias holboelli,* was given by Dr. Kroyer, more than ninety years ago, in honor of a Danish naturalist, the same man for whom Holboell's Grebe was christened.

It is a great, unlovely-shaped fish with very small eyes, a large mouth well furnished with teeth, and coarse fins placed far back. From the crown of the head there sprouts a long, slender tentacle tipped with a luminous lure, the "chandelier" of the fishermen. In general shape this structure resembles a rod, line and bait, the latter suspended directly above the gaping mouth. Well behind it a second ray arises, a mere bare lash directed backward.

These two isolated tentacles are the modified first and second rays of the dorsal fins, widely separated from the remaining four, and greatly elongated.

Much of the surface of the body is covered with large, swollen, spine-tipped, hard, whitish tubercles. Altogether it is as unattractive looking a product of the sea as can well be imagined.

At first nothing of especial interest was noticed about the fish, but closer examination revealed one of the most amazing phenomena known in all the world of vertebrate animal life—a diminutive, parasitic male fish grown fast to the rough skin of the huge female. It is attached to the right side of the abdomen, at the vertical of the gill opening. The great female weighed twenty pounds when caught and measures, over all, thirty-three and a half inches, or 850 millimetres. The tentacle and bait are ten inches long, while the male is only one and a half inches from head to tail.

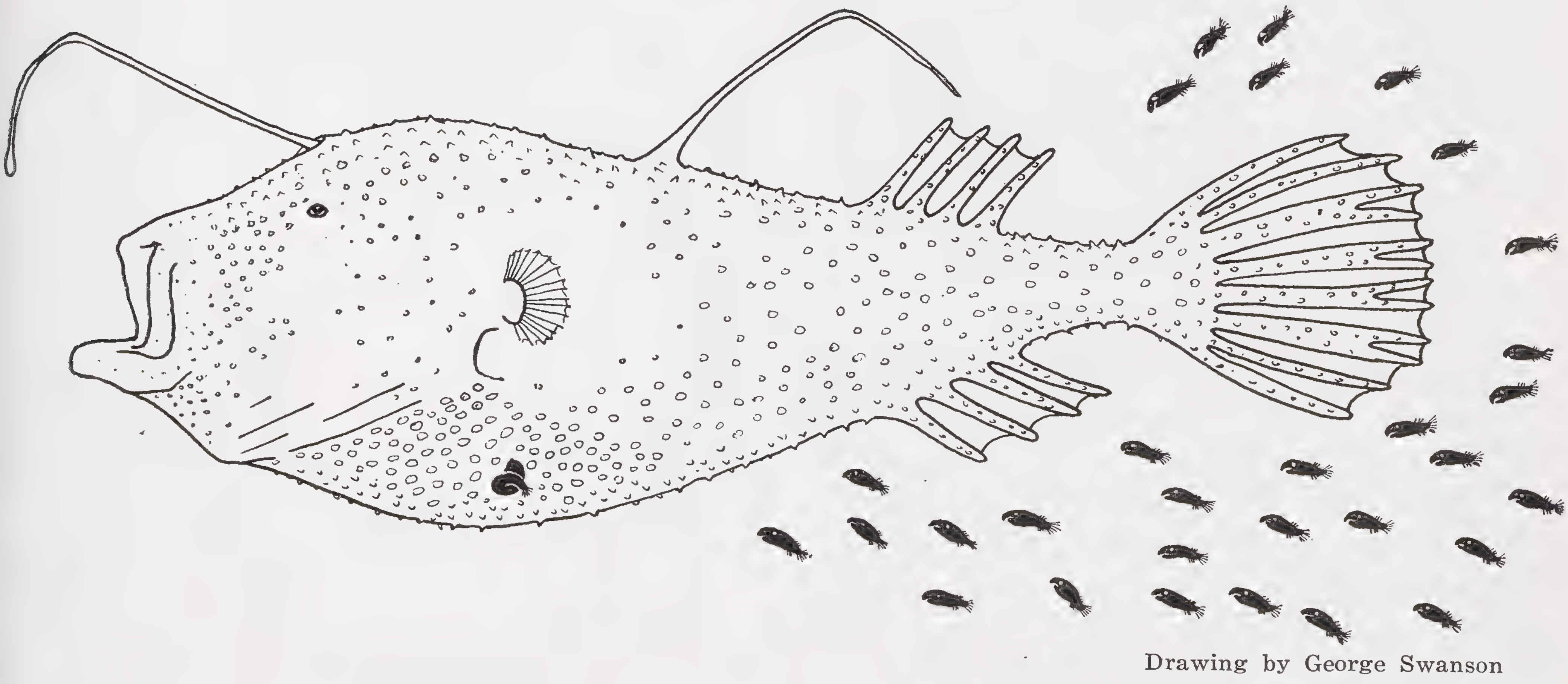
I have never taken a specimen of the female of this particular deep-sea angler at our Bermuda station, but we have caught more than two hundred of the small, lightless fish which have been classified under the family Aceratiidae. These seem unquestionably to be the diminutive males, which, less than two inches in length themselves, with no luminous lure, but overdeveloped narial sense, search for the giant females, and when one is found attach themselves to her skin for the rest of their lives.

We have only the circumstantial evidence of a great number of these small anglers, which are invariably males, and the direct proof of an occasional capture of one of the gigantic females, sometimes alone in life, or with one, two or even three dwarfs growing head-on to her unattractive spiny skin. And we have the radical change in the physical makeup of the males from the time when they are young and free-swimming until after they have become an integral part of their mate. There is no simile or metaphor about this complete oneness of union.

As far as we can tell, the search, the finding, the marriage of *Ceratias* must be somewhat as follows: The males of several families of these anglers or sea-devils never exceed two inches in length. They have no lure, either fleshy or luminous, and their dominant sense is that of smell, the nostrils sometimes occupying the entire front of the head. They are fairly good swimmers and have well-developed eyes.

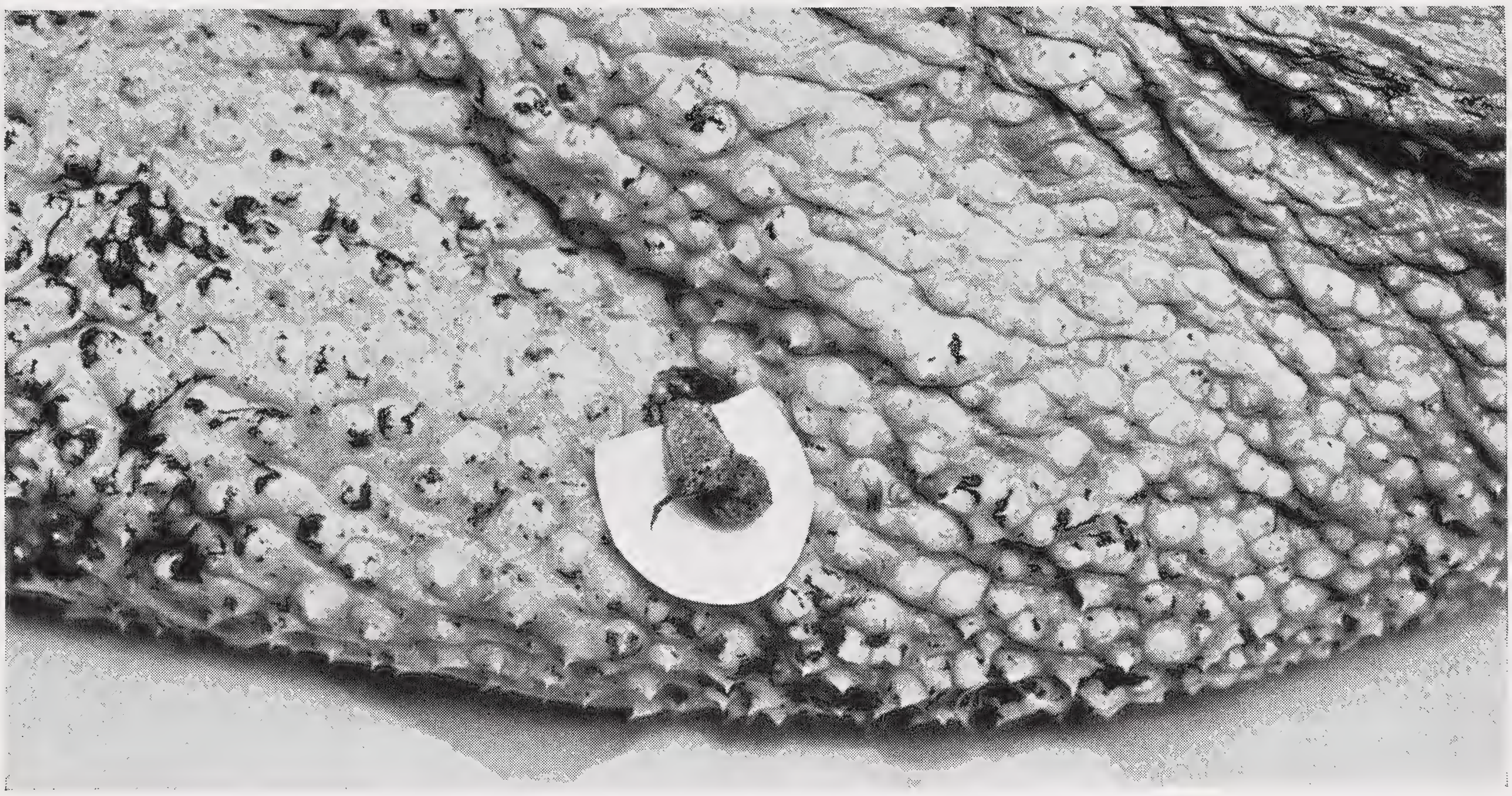
They must be hatched in great numbers, how or where we do not know. But they swim through the cold, black depths of the sea from a quarter of a mile to a full mile below the surface. In the course of time, one out of perhaps thousands scents a female and reaches her. She is relatively enormous and her capacity is such that, given the opportunity, she could easily swallow a hundred of the little males at once.

From external appearance the dwarfs seem



Drawing by George Swanson

This sketch of Holboell's Angler shows the parasitic, dwarf male attached to her side. A swarm of free-swimming males is following, drawn by the scent of the female and waiting for a chance to attach themselves—on the side, below the body, or even between the eyes.

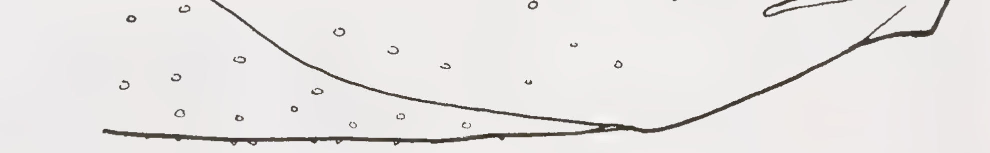


Here is a close view of the attachment of the male to the rough, spiny skin of Ceratias. *The dwarf's tail is twisted over its back and neither eyes, nostrils, mouth nor body fins are visible. A piece of white cardboard has been slipped under the male to make it more distinct.*

to be normal fish, and while free-swimming some of them have already become adult, and probably swim along, from now on, in close proximity to the giant female, until she deposits her eggs in the water, when the small male fertilizes them. But others remain immature until their long search is ended. These waste no time but rush at the object of their emotions and take a firm hold wherever they chance to touch. This may be on the side or below the body or even on the head between the eyes. Some are furnished with an array of lip bristles with which they maintain a tight grip while, in some way, they chew directly through the skin. Like the gall on a plant induced by the sting of a tiny wasp, the irritation of the gnawing male produces a low but distinct growth at the raw area. This soon unites with the capillaries in the mouth of the male and a permanent, Siamese-twin attachment results.

Nourished by the flowing blood stream of the gargantuan female, the muscles of the male, its sense organs, digestive tract, the very skeleton itself gradually disappear, and simultaneously it becomes adult. From now on, throughout all her life, the gentler sea-devil sex swims on her way with the tattered remains of one, two or three suitors dangling from her body.

Our anthropomorphic imagination can sympathize with a diminutive male spider climbing down the web of his prospective consort, gambling a moment of passion against almost certain death. At least he will have provided a lunch for his brobdignagian bride. But to be driven by impelling odor headlong upon a mate so gigantic as *Ceratias,* in such Stygian darkness, and wilfully to eat a hole in her barbed-wire skin, to feel the gradually increasing transfusion of her blood through one's veins,



Drawing by George Swanson

Head of a dwarf, free-swimming male sea-devil showing the large eye and nostril, spiny skin and cluster of false teeth. Although now placed in a different genus and family, this species may prove to be the parasitic male of Ceratias.

to lose everything that marked one as other than a worm, to become a brainless, senseless thing that was a fish—this is sheer fiction, beyond all belief unless we have seen the proof of it.

This condition of a dwarf parasitic male combined with enforced physiological polyandry would arouse only moderate astonishment in certain groups of invertebrates. Our mind goes back to the paper nautilus, the squid-like male of which is extremely small and which, in the process of matrimony, entrusts its mate with one of its living arms to treasure within her shell for the purpose of fertilization when the eggs are laid.

But such happenings are unknown among the groups of backboned animals. Only from the depths of the ocean could such a phenomenon be conceivable, and here in our laboratory in the Zoological Park is the chandelier fish and its mate, bound to it for better or for worse, by literal flesh and blood.

Did she know he was there? When did the last vestige of sight or smell, of heart-throb, of individual instinct and sensation leave the little being? What particular theory or combination of theories of evolution can explain the gradual development through past ages which has culminated in this self-immolation on the altar of generation?

Grouse of the Northern Barrens

Within a Few Weeks the Willow Ptarmigan Will Return to Its Summer Range on the Mossy Wastes of the Arctic

Ben East
Nature Editor, Grand Rapids Press

APRIL has arrived. It is early spring across the northern United States. The skunk cabbage is lifting its striped cowls in the swamps, the alders and willows are shaking out their catkins along the swollen streams. And in every favored district from the birch forests of Minnesota to the hillside thickets of Connecticut, from the fir-scented woods of Maine to the laurel-clad slopes of the Smokies, the naked woodlands are throbbing with the rolling thunder of ruffed grouse atop their drumming logs.

That is the northern spring's own song, that pulsing wing music of the partridge. It rolls through the leafless woods like the ruffle of distant drums, starting in a slow and measured beat, throbbing faster and faster until it ends in a blurred, ecstatic clan call of the wild. I know no bird song of the spring, save perhaps the eerie winnowing of the jacksnipe in the high blue vault above the greening marshes or the cadenced calling of the first whip-poor-will in the cool dusk of early May, that I am so glad to hear.

Farther north, in the dark spruce swamps and tamarack bogs of the Canadian wilderness, up across the black forests of Quebec and Ontario, another grouse is voicing the ardor of the season with his wings. There it is the spruce grouse, a queer bird who cannot learn the lesson of fear, who struts and parades through the thickets of Labrador tea as the great springtime urge wells within him, who finally climbs gravely up a leaning tree trunk, beating his wings as he goes, or drums in full flight as he soars up to a low branch and down again.

But it is even farther north, beyond the Height of Land, beyond the spruce forests, that my mind travels for the minute, as I listen to the first ruffed grouse of spring. I close my eyes and picture the bleak, mossy barrens of the Arctic, the cheerless, lonely land beyond the last low fringe of trees. The rolling country of moss and rock and dwarf willow that I saw last summer along the eastern coast of James Bay and Hudson Bay.

For there are grouse there, too. And if their courtship season is not yet at hand, at least it is near. The first rocks are appearing from under

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All photographs by the author.

Among such barren wastes as these the collecting expedition pitched its camp, for this is the kind of terrain that is favored by the ptarmigan. Among these mossy rocks the far-northern member of the grouse family is as abundant as partridge in Michigan or pheasants in Iowa.

the melting drifts, the first naked patches of moss showing on the southern slopes. Within a few weeks at most the willow ptarmigan will be returning to their summer range.

The barrenlands will resound then with the hoarse hooting of the male birds, the frozen wastes that slope down to the frozen sea will witness many a battle for possession of a shy brown and white hen.

I should like to be there in the far north, to watch the wooing and nesting season of the willow grouse.

Similarly I should like to be on the barrens in September. I chance to be a bird hunter. I thrill to the work of a good dog, to the colored livery of autumn, the gold of the birches, the crimson of the sumac on the open ridges. But if I were given the chance to go anywhere I chose on the North American continent for the bird season next fall, I'd forego the grouse covers along the south shore of Lake Superior, the prairie chicken shooting of the west, the quail country of the south, the woodcock bogs of New York, the famed pheasant lands of Dakota. I'd elect to go north, to the Hudson Bay barrenlands, for willow ptarmigan.

The rolling, treeless hills of Cape Jones, where Hudson Bay opens out from the narrower funnel of James Bay, the bleak coastal islands from the Fort George river north, the desolate shores along Long Island Sound—not the one you've heard about all your life—rank among the most productive bird country I have ever seen.

Ptarmigan, the grouse of the far north—near kin to the ruffed grouse, spruce hen, sharptail, prairie chicken and other members of the far flung and much loved clan—are as abundant on those dreary barrens as partridge in good Michigan cover or pheasants in the cornfields of

Iowa. There on the mossy hills at the southern end of Hudson Bay one member of the grouse family still dwells in primitive abundance, in heartening contrast to the sorry example of the heath hen of New England, enlisted now in the ranks of the extinct.

It has not been my good fortune to see the country of the ptarmigan either in spring or fall. It was mid-July when the *Venture* came in out of the sea, to the lee of a low island off the mouth of the Seal river just south of Cape Jones, where we found our first coveys of these northern grouse.

An Arctic trading schooner, the *Venture*, two-masted, sturdy, almost as versatile and reliable as Jack Palmquist, James Bay free trader who owns and skippers her, with a crew that consists of Allego and George Georgeskes, Eskimo and Cree respectively.

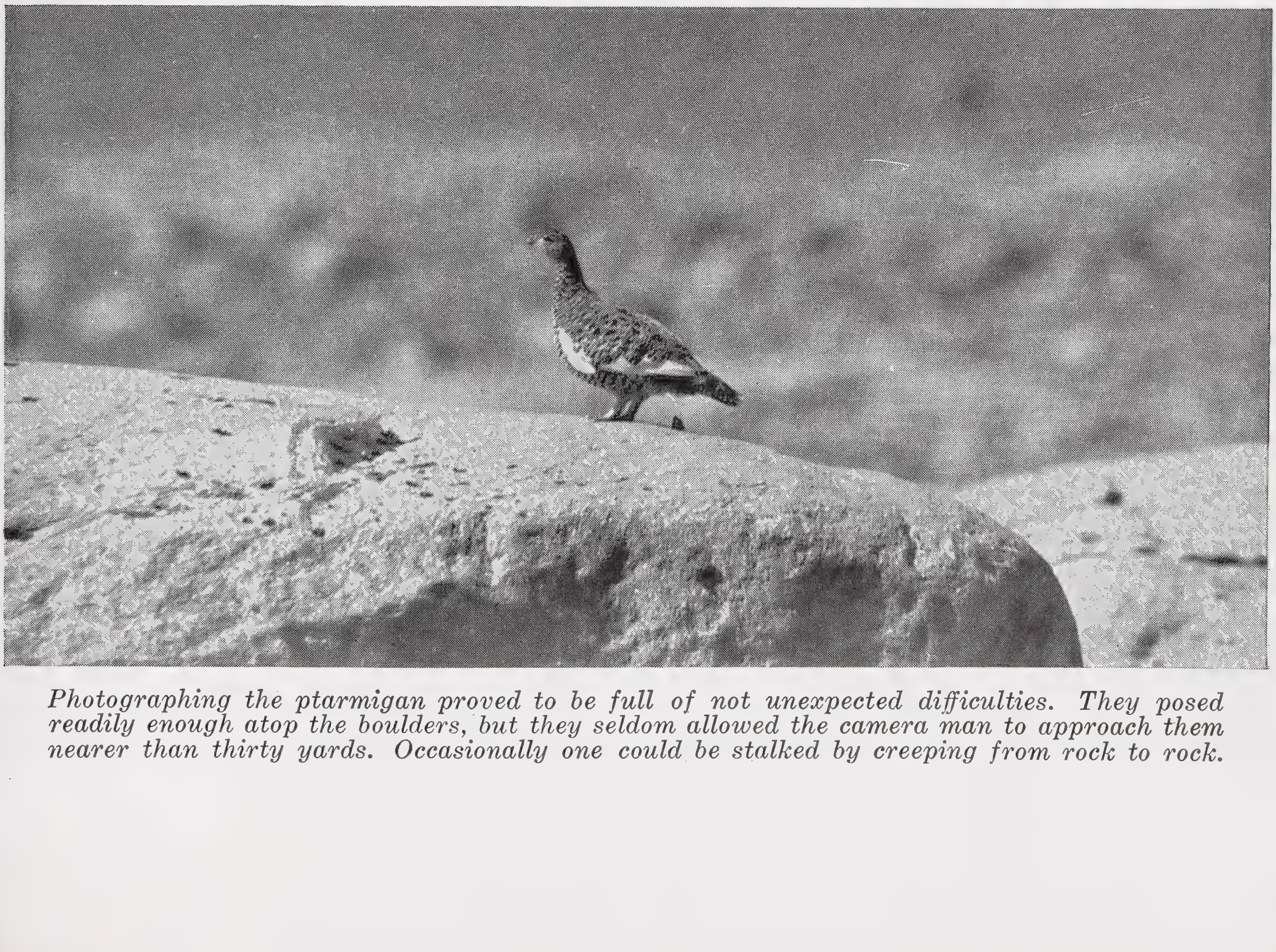
There were eighteen of us in the party aboard her, fishermen, photographers, writers, collectors, vacationists, guides, in charge of Lloyd Melville, Canadian outfitter who had organized the trip.

While Melville and his guides crossed the little bay at the mouth of the Seal river in two canoes that afternoon, to gather tent poles at an abandoned Cree camp site, Howard Cooper, Jane Carrott, my wife and I started with gun and cameras across the island where our camp was to be pitched, on the lookout for our first ptarmigan. They were not hard to find.

Without fail, the low islands along that barren coast seem to have one or more fresh water ponds or shallow lakes, lying like silver saddles astride the rocky and moss-grown ridges. We never went ashore on an island in the barrenlands, on the *Venture's* cruise from Moosonee north to Long Island Sound, but we found these small lakes, sometimes one, sometimes a chain. They were our regular source of drinking water throughout the time we camped north of the limit of trees.

The island at the mouth of the Seal was no exception. When we climbed from the sea to the top of the low ridge that formed its backbone we found two ponds lying just beyond. A deep worn caribou path, mute reminder of the great Cape Jones herds of a quarter century ago, connected them. In a shallow draw between them dwarf willows formed a thicket of low cover.

As we came down to this willow tangle a bird rocketed up from its margin, followed almost instantly by another. We had flushed our first pair of ptarmigan.



Photographing the ptarmigan proved to be full of not unexpected difficulties. They posed readily enough atop the boulders, but they seldom allowed the camera man to approach them nearer than thirty yards. Occasionally one could be stalked by creeping from rock to rock.

They flushed fast but not with the heart-stopping thunder of the ruffed grouse. In midsummer plumage, they were mottled brown and black and gray above, but with a large amount of white on the wings and underparts. Their flight was not unlike that of prairie chickens.

They sailed off, some two hundred feet, alighted and walked restlessly away, clucking and protesting, with hardly more show of fear than might be expected of a spruce grouse.

We went on, a dozen steps or so, along the edge of the willow thicket, and a third ptarmigan burst into flight, literally under our feet. This one was smaller than a quail, however, and it lacked the white markings of the first pair. An instant later two more flushed, and then a bunch of three or four.

We had walked into the area where the brood of half-grown chicks was hiding, as perfectly secreted by their mottled plumage against the multi-colored background of moss and rock as any ruffed grouse chick that ever "froze" beneath a sheltering sweetfern thicket.

The family scattered like a covey of quail but the old birds refused to leave the neighborhood and we went on and left them to reassemble the family.

We carried permits from the government of Quebec for the taking of a reasonable number of ptarmigan. Cranbrook Institute of Science, for which we were collecting, wanted a series of skins. And we, ten days out from Moosonee and growing almost as tired of speckled trout as of bacon, frankly wanted ptarmigan stew. But not badly enough to orphan a brood of chicks that appeared hardly old enough to shift for themselves.

We camped in ptarmigan country for ten days, moving up and down the coast, and wherever we went, on the mainland or the small islands that fringe the shore, we found covey after covey of the grouse of the barrenlands. At that, they were by no means as plentiful as in former years, we were told. Melville estimated he had flushed as many as a hundred and fifty ptarmigan from an acre at the mouth of the Ossogassie river in former summers.

Does that mean, then, that among these birds of the Arctic there are cycles of abundance and scarcity, as among the ruffed grouse? No one knows, but the things Melville and Palmquist reported hint strongly at the possibility.

Each ptarmigan covey we encountered consisted of a family party. The cock and hen bird remain together for the duration of the brief northern summer, sharing equally the responsibility of caring for the brood of young, which may number up to a dozen.

Most of the chicks were big enough for flight by the time we reached the barrens, many of them more than half grown.

The old birds were surprisingly tame, in many cases even bold in their efforts to guard and protect the young. Their brown, black and white coloring serves perfectly to hide them among the rocks, moss and low brush. We never saw them until they flushed, frequently almost under foot. Once driven into flight, however, the adult birds made no further effort to hide.

Sometimes the cock and hen would sail off a dozen rods or more while the chicks stayed motionless and invisible on the ground. More often the old birds flew no more than forty or fifty feet. On alighting they walked away in plain sight or paced back and forth, clucking and talking to the hidden brood.

Perversely enough, but not at all unexpectedly, we found them the most wary and difficult of approach when we tried stalking them with camera instead of gun.

We collected a pair on Cape Jones one afternoon, after we had satisfied ourselves that the chicks were old enough to look out for themselves, and it was necessary to back away a dozen yards to avoid shooting the hen bird at too close range. As long as we stayed near the brood she ran back and forth, hopping from rock to rock, never going more than twenty or thirty feet from us. At the shot, the cock who had been skulking along the edge of a willow thicket took wing but his flight was short, taking him hardly out of gun range, and we killed him without walking ten paces.

A day or two later we encountered a family party on a small rocky island and went after them with the cameras, leaving the guns in camp.

The birds proved wary in the extreme. They kept thirty to fifty yards ahead of us, alternately running along and making short flights, leaving the chicks without hesitation. Photographing a bird the size of a ptarmigan at thirty yards hardly gives satisfactory results, so we changed our tactics.

We tried driving the pair toward the hidden camera man, but with little success. Suspicious, the birds made wide circles and evaded us with little difficulty.

Finally we sat down, smoked and let them recover from their nervousness. By that time we had flushed and scattered the chicks. We knew the hiding place of one or two of the latter, in willow clumps. We could see the hen, moving about in a mossy ravine some distance away, running up on rocks now and then for a quick look around. Finally we spotted the cock in a lookout pose on the top of a big boulder at the far end of the ravine.

Bill O'Conner, who was helping me, offered to sit still and act as a decoy to keep the bird's attention riveted. I made a wide circle, across the ravine, over rocks and moss, finally discarding my hat and going flat on my stomach when I came near the ptarmigan, pushing the heavy camera along ahead of me.

Inching along, I finally gained the shelter of a big boulder that I had marked at the start as the one from which I could get my picture at close range.

But alas, I had mistaken my rock. I was hiding behind the one on which the bird was perched, not the one I had chosen twenty feet away. Cautiously I worked the camera up and poked it over the top of the rock—literally in the face of a badly startled cock ptarmigan. Needless to say, he left in a hurry.

Shooting the few birds we needed for skins was easy enough. Our only difficulty lay in selecting adult pairs whose coveys of chicks were old enough to take care of themselves. We had no desire to destroy an entire family through unwise collecting.

The Cree Indians of the James Bay region live primitive lives, taking what they need from the bleak land without regard to the hunting laws of the white men. They are skillful hunters and a Cree guide with the collecting party was able to "call" a ptarmigan chick into his hand.

We killed a pair on the mainland near the mouth of the Seal river one evening, and Tommy Lameboy, our aged Indian pilot from Fort George, staged a remarkable exhibit of the hunting skill of the Crees.

He located the flock of chicks skulking in the moss a few yards out from the edge of a growth of willows. Hidden in the brush, he clucked softly, imitating the noises of the hen ptarmigan. Within three or four minutes he had called one of the chicks up within reach. His hand swept out in a quick, deft motion and gathered in the youngster.

He brought it proudly over to us but he hastened to tell us, through Palmquist, on whom we relied as interpreter at all times, that we could not have the chick to kill.

Hunting the adult birds was all right so far as the old Cree was concerned, and entirely in keeping with his code. The northern Crees have no game or fish laws to follow. They take what they need from the bleak land where they range, the year around, in any way they can get it, with gun or net or trap, without regard to bag limit or season. Tommy had his mind set quite definitely on ptarmigan stew each time we started out after a pair of skins, and hunted with an earnestness that was in keeping with his desires. "He's better than a Pointer," Jack Palmquist commented more than once, as the old Indian led us unerringly to the spot where a covey of birds was hiding. But killing the chicks was another matter entirely. If we wanted those we would have to get them without his help, the good natured old Cree explained pleasantly but firmly.

We assured him we did not want anything but old birds. His captive was freed and Tommy watched, grinning, while the chick sailed away to a new hiding place, and the hunt went on.

Throughout the summer these willow ptarmigan live on the barrenlands beyond the limit of trees. The hen birds nest in shallow depressions in the moss, sometimes in open, unsheltered locations, sometimes protected by a clump of dwarf willow or birch.

While the short northern summer lasts food is plentiful for the growing family, despite the barren character of the country. Berries of many varieties grow in abundance on the thick carpet of moss. These, together with buds, leaves and other delicacies, supply the birds with a lavish feast all summer long.

As autumn approaches and the weather turns colder the ptarmigan discard their dark summer plumage for one of pure white, that serves to protect them more effectively from their enemies when the snow comes. In this they follow the custom of the Arctic and snowshoe hares, the weasel and other dwellers of the snow country.

Unlike the other members of the grouse family, they are migratory. When the cold storms of early winter sweep across the frozen barrens they drift south in big flocks, sometimes hundreds of miles, moving down into the spruce timber below the tree line, where they find shelter and an abundance of food, budding on willow, birch and aspen, like any grouse.

In connection with this winter flight of the ptarmigan there is told an interesting story of bird migration, to the effect that these far northern grouse once appeared regularly in winter on the Keweenaw Peninsula and at other points along the south shore of Lake Superior.

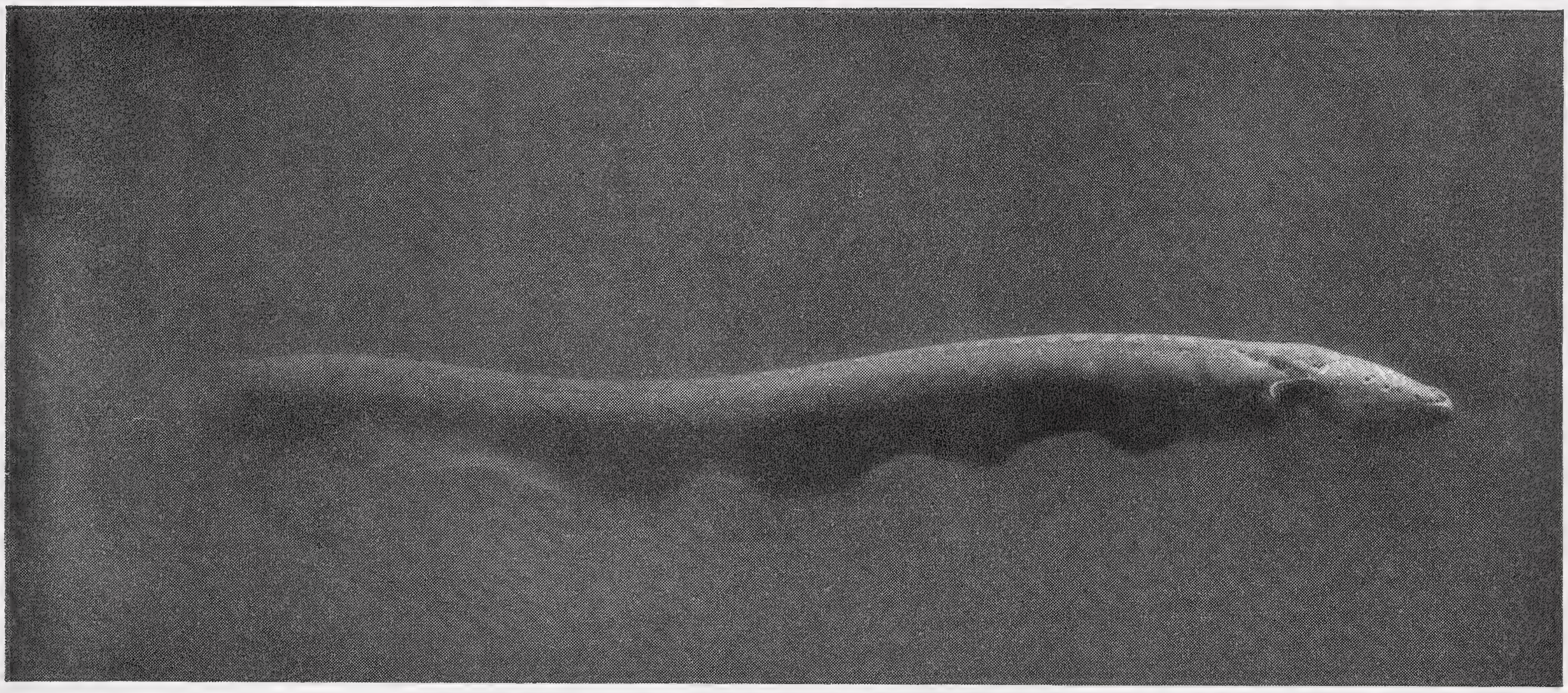
Lumberjacks and hunters of the early days vouch for the presence of this white grouse around the logging camps of northern Michigan in winter, describing it as very tame, sometimes fed by cooks around the shanty door. One woman described the bird clearly as "a big white dove with legs like a Brahma chicken." That could hardly fit any bird of the northern forests save the ptarmigan in winter plumage.

How, then, did these migrants reach the Keweenaw district? If they came in direct line from the northern barrens they made a flight of a full hundred miles across the open, storm-swept waters of Lake Superior, pushing out across water so wide that they could not begin to see the far shore at the beginning of the flight. That seems incredible for migrating grouse.

Yet otherwise they must have rounded the eastern or western end of the big lake and traveled two hundred miles or more along its south shore, which seems equally strange.

Not all of the ptarmigan migrate south from the barrens of James Bay and lower Hudson Bay for winter. Or if they do, then their places are taken by others of the tribe that come down from summer homes even farther in the bleak north, to judge by the things Palmquist told us.

He winters regularly at his trading post at Old Factory river, south of Fort George, and travels widely with the natives. It is not at all unusual, he says, to flush white willow grouse from behind rocks or out of shallow depressions on the snow-blanketed wastes of the barrenlands in the dead of winter. The Crees see them often as they tend their fox traps along the coast, and hunters crossing Cape Jones with their dog teams on the way to the off shore sealing grounds frequently startle the white birds into flight.



The long, cylindrical, greenish-black body of the electric eel glides lazily through the murky water and as it swims it emits a weak discharge of electricity, perhaps as a warning to enemies to keep away. Its digestive system occupies the front fifth; all the rest is power plant.

The Electric Eel at Home

Research into Its Discharge Was Begun at the Aquarium and Continued in Its Native Waters in Brazil

R. T. Cox
Department of Physics, New York University

OF all electrical phenomena except lightning, probably the one longest known to men is the discharge of electric fish. Some 2,500 years ago, Thales of Miletus observed the electric attraction of bits of chaff to rubbed amber, but before that the hieroglyphic writers of Egypt had joined the symbols of fish and thunder to make a sign for the electric catfish of the Nile. The discharge of electric fish was also the first electrical phenomenon to be applied to the use of men. Long before the first dynamos turned, the Indians of Surinam were using the discharge of the electric eel in the treatment of disease.

Yet, though electric fish have been known so long, and though they have been studied by such men as John Hunter and Alexander von Humboldt among the biologists and naturalists and, among the physicists, Henry Cavendish and Michael Faraday, a great deal still remains to be known about them. For neither the experimental technique developed in the study and use of transient electrical phenomena nor the knowledge of biochemistry and biophysics acquired in recent research have been much applied to their study.

Three years ago, with the electric fish of the New York Aquarium for observation, Mr. Coates undertook the organization of a research combining the resources of several branches of science and members of the staffs of several institutions. After a time it seemed advisable to carry a part of the research to some place where the electric eel was plentiful and could be observed under conditions near those of its accustomed life. The Goeldi Museum of Pará on the Amazon estuary was chosen as the best place for the work. The Dr. Simon Baruch Foundation generously supplied most of the necessary funds and the New York Aquarium made an additional grant in aid. New York University, the American Museum of Natural History, and the editors of *Radio Engineering* furnished equipment. Eventually a party of

Photo by R. T. Cox

The city of Pará was once a fort of the Portuguese against the Dutch; now it is a barrier against the Amazonian jungle, which comes to its very gates. The thin white line on the horizon at the right is the Pará River, and beyond it lies the Isla das Onças, or Island of Jaguars.

three, Mr. Robert S. Mathews as ichthyologist, my wife as general assistant, and myself as physicist, left the United States. After twelve days the ship met the muddy water of the Amazon, where nearly a quarter of the earth's rainfall, draining the surface of almost half a continent, sweeps in a broad yellow flood into the ocean.

The city of Pará, where we disembarked next day, is no common city. Centuries ago, when it was new, it was a fort of the Portuguese against the Dutch, in the days of the rising sea power of Holland. Rusty cannon still stand behind massive stone walls on the water front, but the river is tranquil now and chickens scratch in the dust of the fort. Today the city is held as a post against the jungle, which still maintains the siege of three hundred years. Wherever a tile falls from a wall, some little plant sprouts in the hollow, raising a green leaf as if for an ensign of the great army of the forest, stretching back more than 2,000 miles to the Andes. By land, the city is almost cut off from the rest of the world. Little trains puff patiently under the great trees for 160 miles to Braganza on the seacoast, and back again, for the railroad goes no farther. Roads run a little way out of the city to the surrounding villages, fade into trails, and are lost under trees and vines. To the nearest cities a thousand kilometers is a convenient unit for measuring distances. For, except for the thin line of communication maintained up the river, the frontier of tropical Brazil is still near the ocean, about where the North American frontier was at the time of the Revolution.

But this frontier is not such as the North American is likely to imagine. The North American frontier was always on the march and had much of the camp in its transiency and haste. This frontier has settled into a state of quiet siege, where the Latin culture of the Old World confronts the still older culture of the forest. The towers of the Old Cathedral look out over the city and beyond to the tops of the beautiful suma-uma trees, Gothic in the buttressing growth of their roots. The shade of palms and mango trees falls on the pleasant houses of many soft colors, graceful with tall doorways and intricately charming with tiling and wrought iron. The patient vendor of live boa constrictors, six or eight feet of his goods over his shoulder, looks for his rare customer among the tables on the terrace of the Grande Hotel. And through the port incessantly drifts the traffic of the vast river basin, great balls of crude rubber, bales of deer hides, rafts of a hundred vine-tied logs, each large enough to make a dugout canoe.

On the Avenida Nazareth, which was once the road to the village of Nazareth, now a part of the city, the botanical and zoological gardens lie behind an old wall, and here stand the buildings of the Museum, shaded by the trees and vines of all Amazonia. The little deer walk quietly, agoutis scamper away from the paths, and peccaries root after the rains in the red Brazilian clay. Some of the animals are in cages and some are behind fences, but this is perhaps the nearest the world can show to a voluntary zoo.

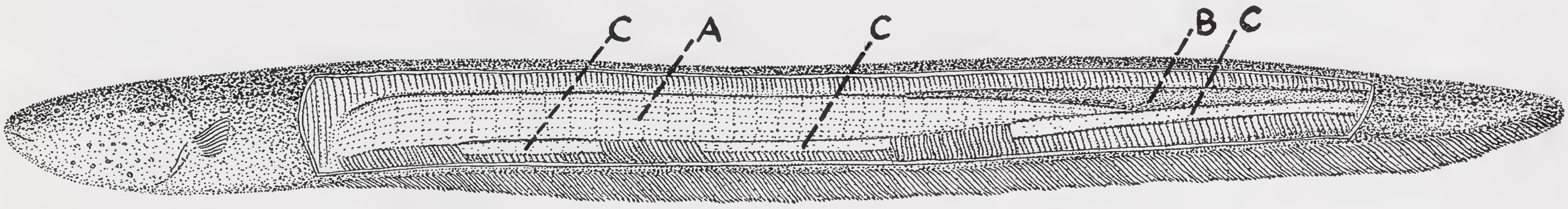
The varied interests of the institution, zoological, botanical, and anthropological, are those of its versatile founder, the Swiss scholar Emilio Goeldi, who came to Pará a generation ago with a few associates. One of these, the amiable and scholarly Dr. Godofredo Hagmann, is now the Chief Mammalogist of the Museum and was its acting director during our visit. To him and to the other members of the staff of the Museum we are indebted for every assistance they could give us. We are equally obliged, both for our supply of electric eels and for much other help, to Mr. Karl Griem and his associates in the Amazonica Company, of which the Brazilian quarters adjoin the Museum.

Behind the principal building of the Museum is a great tree with a pool beneath, and over the pool is the zoo's only sign of warning: "Cuidade! Puraqués"—Beware! Electric Eels. Looking into the water, one sees the long, cylindrical, greenish-black bodies fringed from vent to tail with one great fin, the flattened head, the cloudy little eyes, crowded forward almost to the upper lip. If the fish have lately been fed, they will seem to have their cheeks puffed out with meat; it is not the cheeks, however, but the belly. For there is almost a complete fish in the front fifth of the length of the electric eel; the long posterior column is principally power plant. This is made up of three pairs of electric organs, which comprise half the weight of the fish and were evidently evolved from swimming muscles. The large electric organs start immediately behind the vital organs and extend almost to the tip of the tail. Under these and extending for about the same length, is a pair of smaller organs known as Hunter's organs. Starting about midway down the fish and thickening for a distance toward the tail, is the third pair of electric organs, known as the organs or bundles of Sachs. Whatever the fish has lost in swimming power by the evolution of these organs from swimming muscles appears to be more than made up by the development of electric power. Being able by electric shock both to repel its enemies and to stun the smaller fish it needs for food, it has no need of speed either for escape or attack.

The reason for the division of electric power among three pairs of organs was at first obscure to us. Our observations in New York had shown a major discharge, which appeared to be that of the large organs, and which attained in a fish of mean size, about a yard long, an electromotive force of about 300 volts. We had observed also a minor discharge, with an electromotive force only about one-tenth as great, which was evidently the discharge of Sachs' organs. A third discharge, irregular in voltage, seemed probably to be that of Hunter's organs. It was hard to see of what use so weak a discharge as that of Sachs' organs could be to the fish, and offhand it would seem to its advantage to release all its power in a single discharge.

But listening with telephones to untamed puraqués swimming in a pool seemed to throw some light on the question. Most of the day the fish lay quietly in a shady part of the pool, only rising now and then to gulp air. But from time to time one would slide away from the others to cruise around the pool. It was my wife who noticed first that whenever an eel was swimming there could be heard in the telephones the little click of the minor discharge. At some stir in the water near the fish, the major discharge would crash like a burst of static in a loud-speaker, almost lifting the telephones from the head. Now it has been reported that non-electric fish of the same family and shape as the electric eel are often found with badly bitten tails. It seems likely that the electric eel escapes this mischance by warning its enemies with the iteration of the minor discharge. Sachs' organs would thus be like the one-pound gun at the bow of a warship, using little power itself but giving notice of the powerful batteries that can be discharged in emergency.

It may be also that Sachs' organs, and the others as well, serve the puraqué in a primitive telegraphy, supplementing a deficient sense of sight. In the larger electric eels the eyes are almost always afflicted with cataract, a consequence (as it would seem from what is known of the incidence of human cataract after severe electric shock) of the discharge of the fish itself. In dissection, Mr. Mathews observed that the optic nerve is slight, and it would thus seem that the eye is not an important organ to the puraqué. On first thought it might appear that the loss of sight is a high price for the fish to pay even for the development of such a valuable faculty as its electric discharge, but it must be considered that its native water is almost opaque with clay, and vision would be limited to a distance of a very few feet at most. Other fish of the region have highly developed senses auxiliary to sight; the ferocious piranha, for example, is quick to follow the scent of blood. That the puraqué has a primitive telegraphic system seems well proved. Mr. Coates observed with the electric eels at the Aquarium that the discharge of one brought the others swimming to the place of discharge. The genial Dr. Paul Le Cointe, Director of the Commercial Museum of Pará and an authority on the Amazon Valley, told us he had seen the same behavior among the wild puraqués of the rivers.



Drawing by Ralph Graeter

This sketch of the "power plant" of the electric eel shows the placement of the various electric organs. "A" is the large electric organ, from which the major discharge comes; "B" is the Bundle of Sachs, which produces a minor discharge; and "C" is Hunter's Organ, apparently emitting an irregular type of discharge. The large electric organ tapers off toward the tail but continues inside and beyond the point shown as the junction of Hunter's Organ and the enlarging Bundle of Sachs. A similar set of electric organs is found on the other side of the fish.

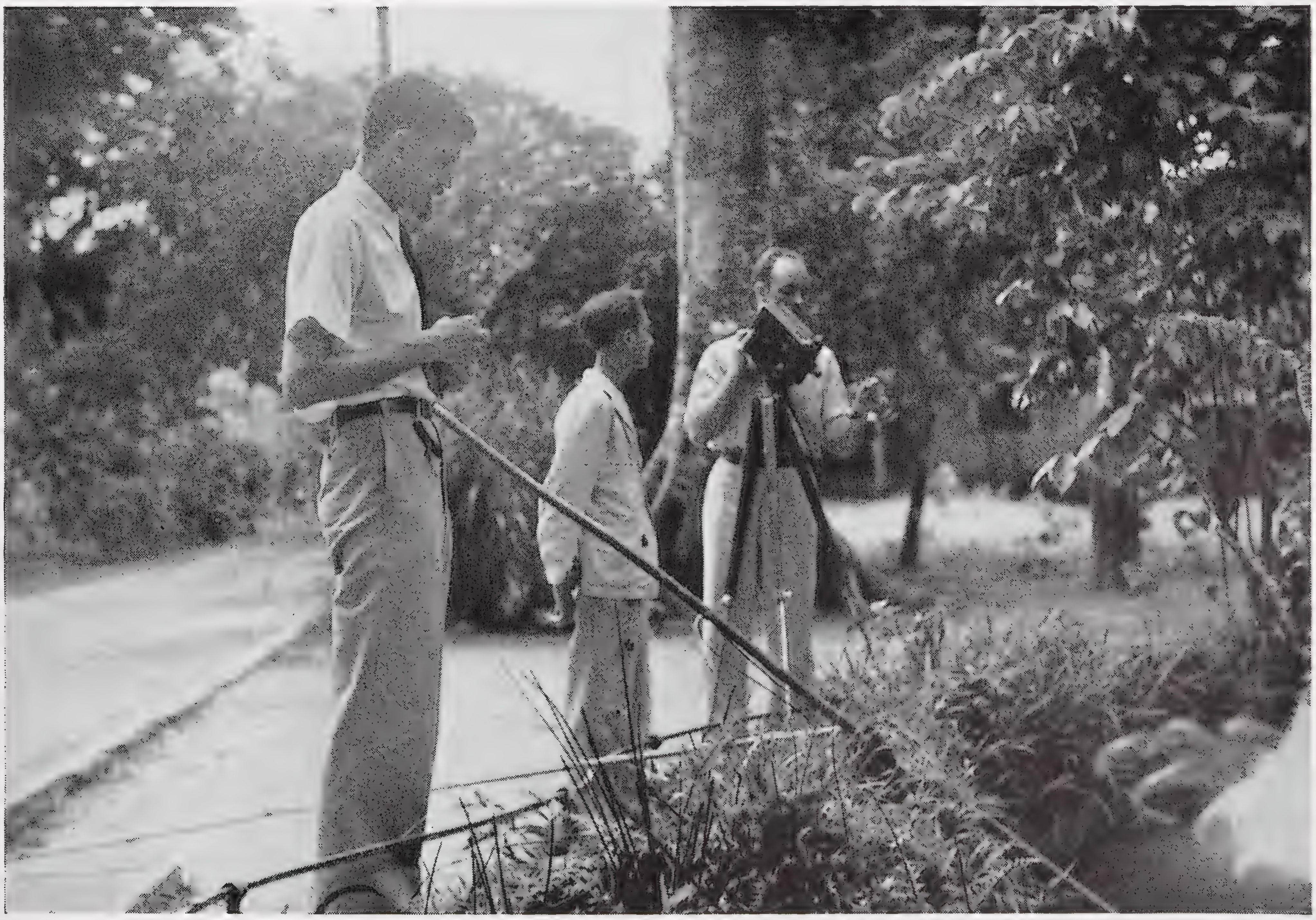
We wished to set up our own electrical communication with the eels. Mr. Bonney, the Chief Engineer of the Pará Electric Company, kindly lent us a little hand-cranked generator for this purpose. Connecting this to two metal plates in the water, we turned the crank and watched the eels. Slowly one or more would turn and swim toward the nearer terminal. At the negative terminal they would not stop, but at the positive terminal they would swim around and around, snouts almost against the plate, adding their own discharges to that of the generator. In the discharge of the eel, the positive end is the head; these eels, it would seem, were looking for the head of a discharging eel, where they might hope to share in prey.

The intensity of such a discharge as we made falls off rapidly with increasing distance from the source, and it was hardly to be expected that we could call the fish from any great distance. The greatest range of our signal appeared to be about five yards. Even at this distance, the sensitivity to electric current which the eel must possess in order to detect the discharge is surprising. Electricians are accustomed to feel for live wires on a 110-volt circuit, and in dry weather they may sometimes moisten their finger tips to increase the shock enough to feel it. If a few thousand electricians were to join hands and the two at the ends of the line were to touch the terminals of a 110-volt line, there would pass along the whole line a current about equal to that which gives a signal to the electric eel. That the eel detects such small electric intensities by nervous shock seems unlikely, since it is able to tolerate the intense current of its own discharge.

Encouraged by our success in calling eels in a pool, we wished to try calling them in the streams where they live. We were therefore very much pleased to receive a courteous invitation from Senhora Vicente de Miranda to visit her cattle ranch on the great Island of Marajo, where electric eels are abundant. The Senhora warned us, however, that high water from the rains, which by that time were well under way, would make it hard to find the puraqués. With the Senhora, a young girl, her companion, and a Negro crew, we crossed the Bay of Pará under a wide blue sail and started at sunset up the Rio Arary under the power of an erratic little Diesel engine. By starlight mostly, for the shore lights were few, we traveled all night up the river. The rains had come, indeed, and what landmarks the pilot found on the drowned land we sailed over it was hard to tell. It was evident, though, that there was a channel to which he was holding the ship, for he turned now and again sharply, spinning the wheel with his bare feet while his hand reached for the signal bell; and once when he turned the wheel over to a helper we promptly went aground.

We passed in the morning across Lake Arary, the source of the river, and came on the far side to the Senhora's ranch. We had not long to stay. The cattle, for which the ship had come, had stood for some time in the corral and were suffering in the intense heat. They were swung on board by ropes around their long horns, the crew hauling buckets of water over the side to throw over the cattle and over the deck, which was scorching the men's bare feet. While this was going on, two of the ranch hands brought up a canoe. (The cowboys of Marajo are amphibian; they catch fish with a net woven in the loop of a lariat.) My wife and I took the eel-calling equipment and a set of head telephones in the canoe, and an old man guided it to where he said puraqués were thick in low water. But though I cranked the generator until my thumb was raw, the telephones gave no sound of the discharge of a puraqué.

The trip to Marajo was not, however, without results for our expedition, for it gave us a



Electricity is a strange kind of bait to use for fish, but it is being used here to draw electric eels toward the edge of the pool in the Goeldi Museum garden so they could be photographed. The bamboo pole extending into the water carries wires and current from a hand generator.

chance we should not otherwise have had to talk with people who had seen much of the puraqué. The cattle were paying for the ship, and any travelers along the river were free to come aboard for any part of the trip they chose. The evening of the first day we were so joined by an old Negro and his daughter on the way up the river for the girl's marriage. He had lived on the island all his life and was well known to the Senhora. We sat in the sultry night and talked of puraqués. The talk passed from one to another, changing language as it went, my English to my wife, her French to the Senhora, the Senhora's Portuguese to the old man, then back the same way, with now and again a little by-passing. We asked about the different colors of the puraqués. This was a point on which we had heard various opinions, some saying that it varied with locality, others with sex, others with season. The old man knew the reddish puraqués and the black, and they were, he said, different kinds. The one kind has reddish sides and a narrow black line down the middle of the back. This kind is found in the larger and more quiet streams, and it is more sluggish in swimming than the black, which lives in the smaller and more rapid streams. The two kinds are found, he said, at the same times of year but not in the same place. Had the old man seen animals killed by puraqués? He believed he had. What had happened was this. He was driving several horses over a shallow stream, when one of the horses screamed and fell. As he reached the horse, he saw an enormous puraqué, perhaps half a meter around, swim over its body, and the horse was dead.

We heard many stories of the deadly shock of the puraqué, of horses struck down at fords, falling with their riders, of yoked oxen swimming the rivers, one being shocked and drowning both, of mules and men killed while swimming. That such deaths occur seems hard to doubt after so many reports from different witnesses, but probably in most cases the shock causes only a severe muscular cramp and death is by drowning.

We inquired also, as we had a chance, about the eating of the puraqué. Senhor Pira, the kindly librarian of the Goeldi Museum, had eaten it; so had Dr. Le Cointe. What of its reported value as a cure for rheumatism and other ailments? Dr. Le Cointe had eaten the puraqué and he had the rheumatism. Of the two he considered rheumatism the more bearable.

Most of our work was done in the laboratory provided for us at the Museum, a pleasant room, high-ceiled and white-walled, the floor even with the ground, doors and windows opening on the tropical garden and giving entrance now and then to some of the free animals of the zoo. Here we laid eels, long and short, one after another, on a long switchboard. Wires led from this to the cathode-ray oscillograph, with which we measured the voltages of the discharge. An ordinary voltmeter, with needle moving across a scale, is useless for studying so transient a phenomenon as the discharge of the electric eel, for a single discharge lasts only a few thousandths of a second, and a whole train of discharges can pass without giving the needle time to come to rest on the scale. In the cathode-ray oscillograph, the moving part is a

The electric eel must be handled with rubber gloves, for it can deliver severe shocks out of water. It can live for hours outside.

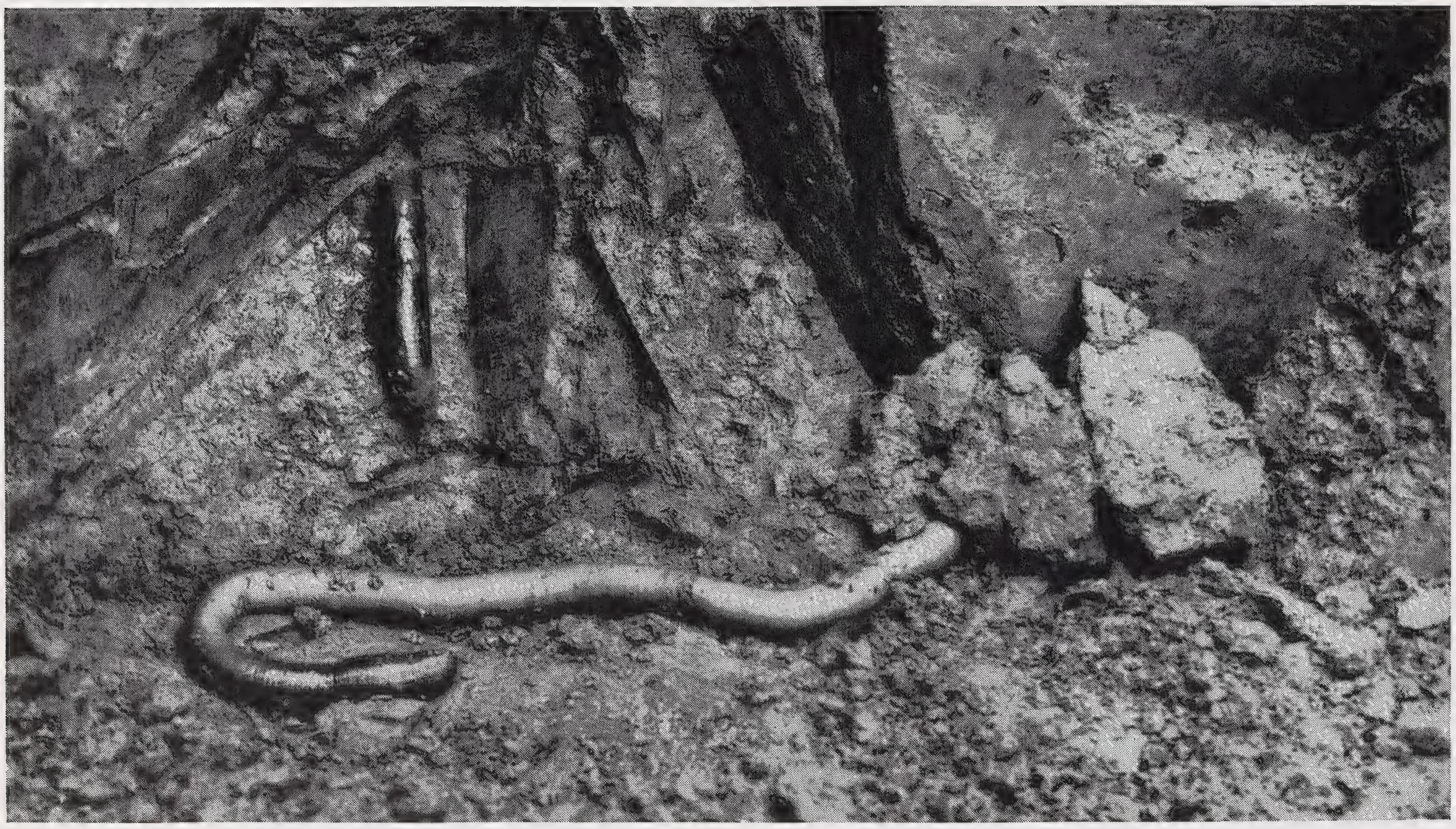
beam of electrons playing on a fluorescent screen. The variations in voltage are shown on this screen by a luminous trace.

As concerns the maximum voltages developed in the discharge, we found no great difference between these eels, fresh from their native water, and the eels we had observed in New York. Although one eel 40 inches long developed an electromotive force of 500 volts, this was exceptional. It seems likely that voltages greater than this would seldom be found even in the discharges of the very large eels, six feet or more in length, of which we had no specimens for observation. For the electromotive forces does not increase proportionately with the length of the eel; the smallest eels we had, only 8 inches long and weighing less than a pound, developed 115 volts. We had two of the reddish eels, a present from a visitor who came through Pará gathering puraqués to show at the Paris Exposition. The discharge of these was similar to that of the black eels.

The first thing to be understood is how the tissue of the electric organs can generate such voltages, against which it has no adequate insulation, traversed as it is by the flow of electrically conducting fluids. To this question a fairly complete answer can be given. The membrane enclosing a cell of ordinary living tissue can insulate against a few hundredths of a volt. Indeed such voltages are generated at the boundaries of all living cells. In recent years they have been studied especially in nerve fibers. In the passage of a nervous impulse, the voltage between the fiber and the surrounding tissue fluctuates, the insulating sheath of the fiber temporarily breaking down from point to point along the nerve. The number of cells along the length of the large electric organ of the puraqué is such that if they were all joined in series, summing their minute electromotive forces, the total voltage generated would be about what is observed in the major discharge. The cells might be connected in series by a transient breakdown of the cell membrane, such as takes place in the nervous impulse. Such a breakdown would have to be inferred rather than seen. Some of our observations in Pará appear to give evidence of it. On this hypothesis, the high voltage observed in the discharge would not exist in the electric organs at any time except at the instant of the discharge. The cells would, in effect, be charged in parallel and discharged in series, a method used in recent years in physical laboratories for the generation of extreme high voltages to produce atomic disintegrations.

In every part of the organ, probably in each separate cell, the discharge is under the control of the nervous system. This is shown by the observation that cutting the nerve cord blocks the discharge at all points posterior to the cut, while cutting entirely through the electric organ changes neither the voltage developed nor the speed with which the discharge runs down the organ from head to tail. This observation somewhat surprised us. The speed of the discharge running down the organ is 500 meters per second or higher, greater by five times or more than the fastest reported nerve impulses. From this we had conjectured we might find some other mode of propagation of the discharge than by nervous impulse, but this conjecture is now untenable.

The research is by no means complete. We are far from being able to trace what an electrician would call the wiring diagram of the electric organs. But certain relations we observed encourage us to hope that it is not hopelessly complex, and we have a number of specimens and a mass of records to help in unraveling it.



Worm-hunters excavated a low bank near a stream and had dug half of a giant earthworm out of the ground when this picture was taken. About an inch and a half from the left, a second giant is emerging, and at the upper right corner two large "wormholes" are visible.

Australia's Giant Earthworm

A "Fishing Worm" Twelve Feet Long Puzzled Its Discoverers When They Found First Specimens Seventy Years Ago

Charles Barrett, C. M. Z. S.

"IS it a snake or a worm?" Surveyors in South Gippsland, Australia, nearly seventy years ago, argued around the campfire, and at last agreed to submit the issue to a scientist in Melbourne. A week or two later Professor Frederick McCoy, Director of the National Museum, was gloating over specimens of the world's biggest earthworm. He described the new wonder from the wilds as *Megascolides Australis,* and gave, in the first decade of his great work on the Natural History of Victoria, a brief account of its discovery and the little then known of the giant earthworm's habits.

Dozens of specimens were collected, chiefly in one fertile valley, that of the Bass River, where the platypus is at home. *Megascolides* has a limited range, for during the past half century it has been recorded from only a few localities, all in South Gippsland, a rich agricultural province.

As settlement followed the survey, and farms replaced primeval forest, the giant earthworm became familiar, at least to men on the land. Thousands must have been destroyed in those early days—and it still goes on. I have seen pieces of *Megascolides* and mutilated specimens lying about on freshly-ploughed land, and picked up many brown, horny eggs in the furrows. These worm eggs are tough capsules, half an inch across and from two inches to three inches long; at one end is a bunch of filaments, at the other a short and pointed extension. Greenish colored and translucent when

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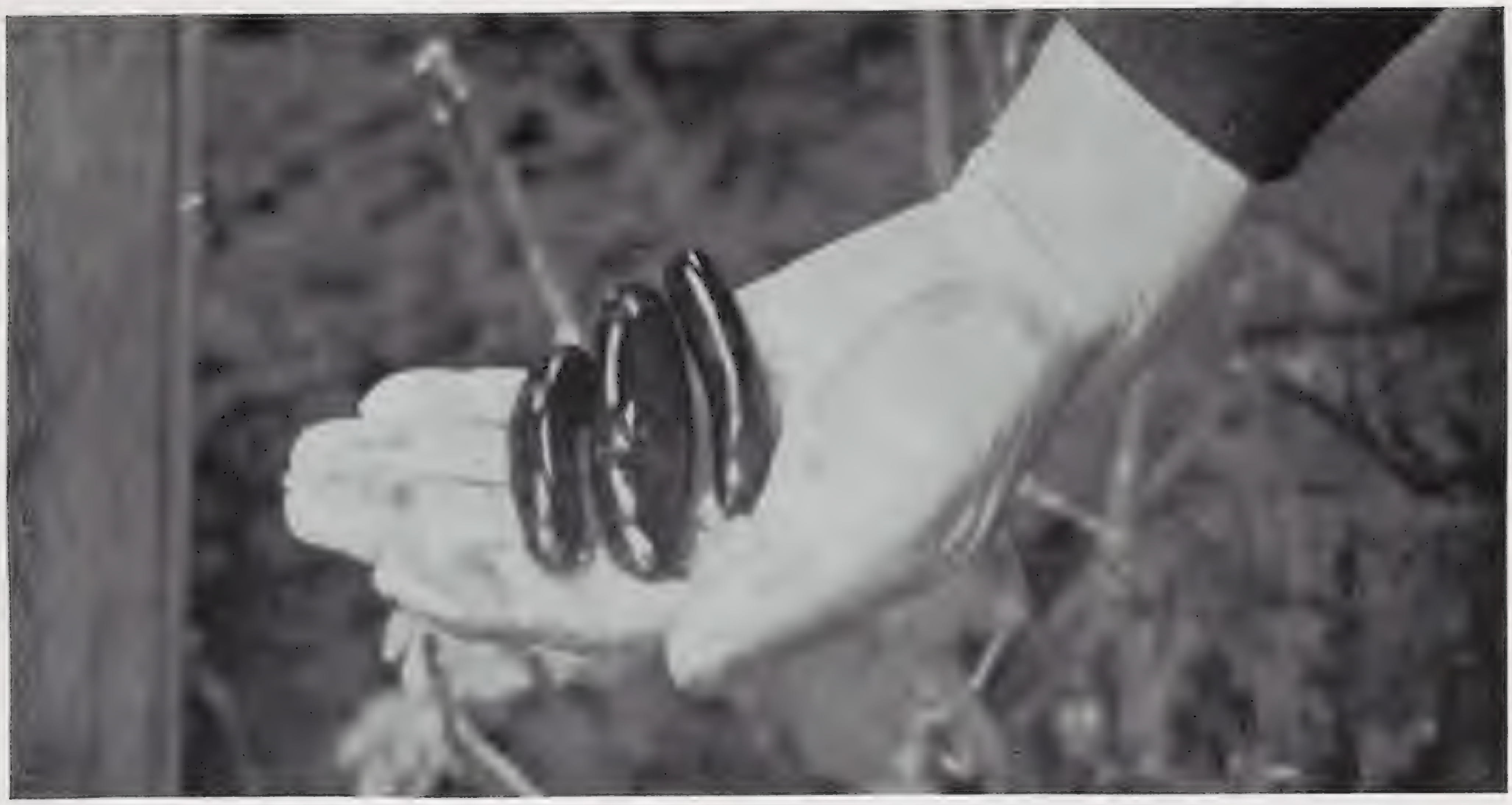
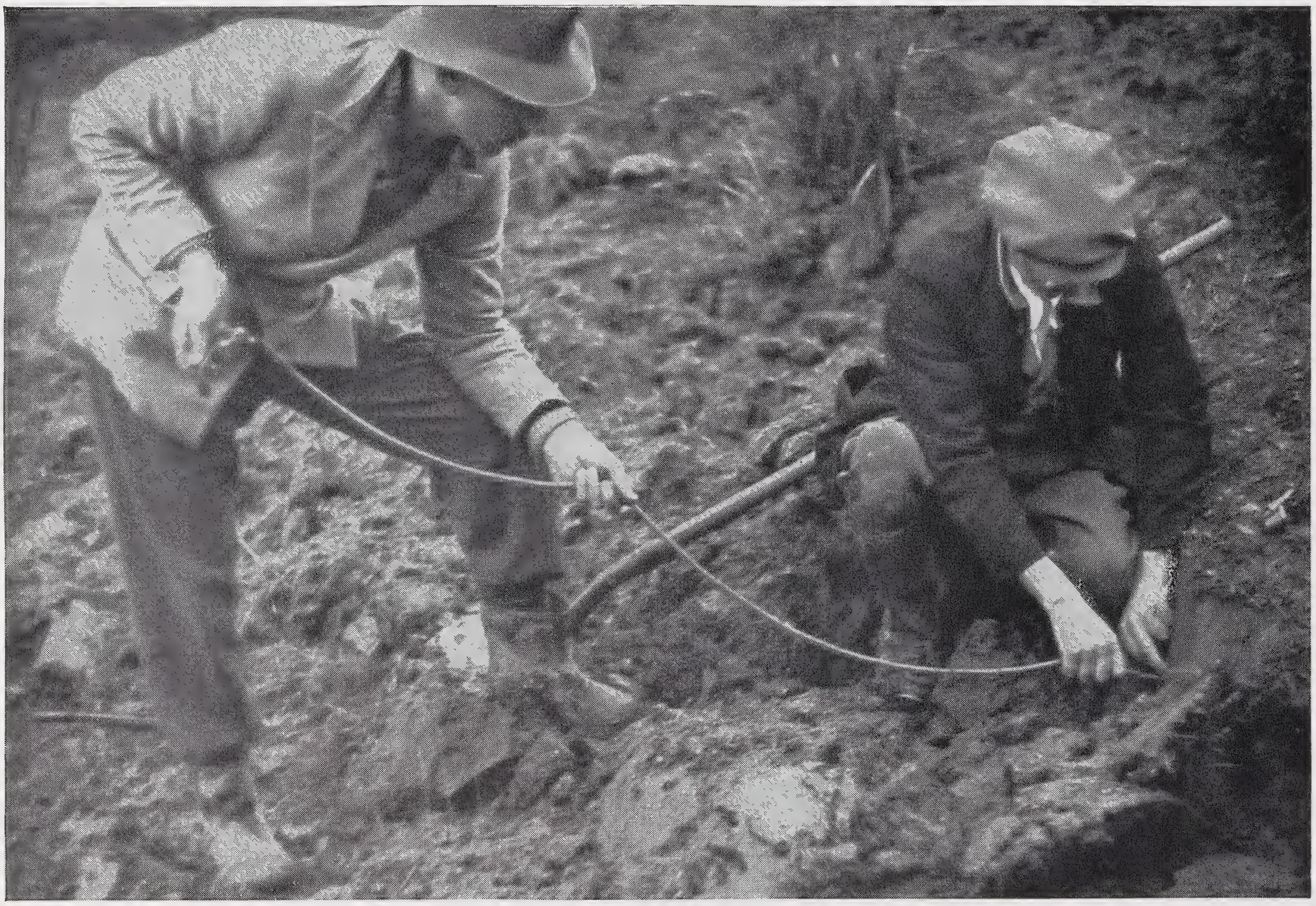
All photographs by the author unless otherwise credited.



Globe Photo

The eggs of Megascolides *are brown, horny capsules half an inch across and two to three inches long. Greenish and translucent when they are fresh, they become dark brown. Eggs can often be picked up in the furrows of freshly-ploughed fields, along with mutilated worms.*

Worm-hunters at work in the Bass River Valley, where the giant earthworms are common on the farm of L. C. Cook. Here Mr. Cook and his son are opening a burrow, and one giant is already draped over the handle of a shovel, as may be seen at the left side of the picture.



Globe Photo

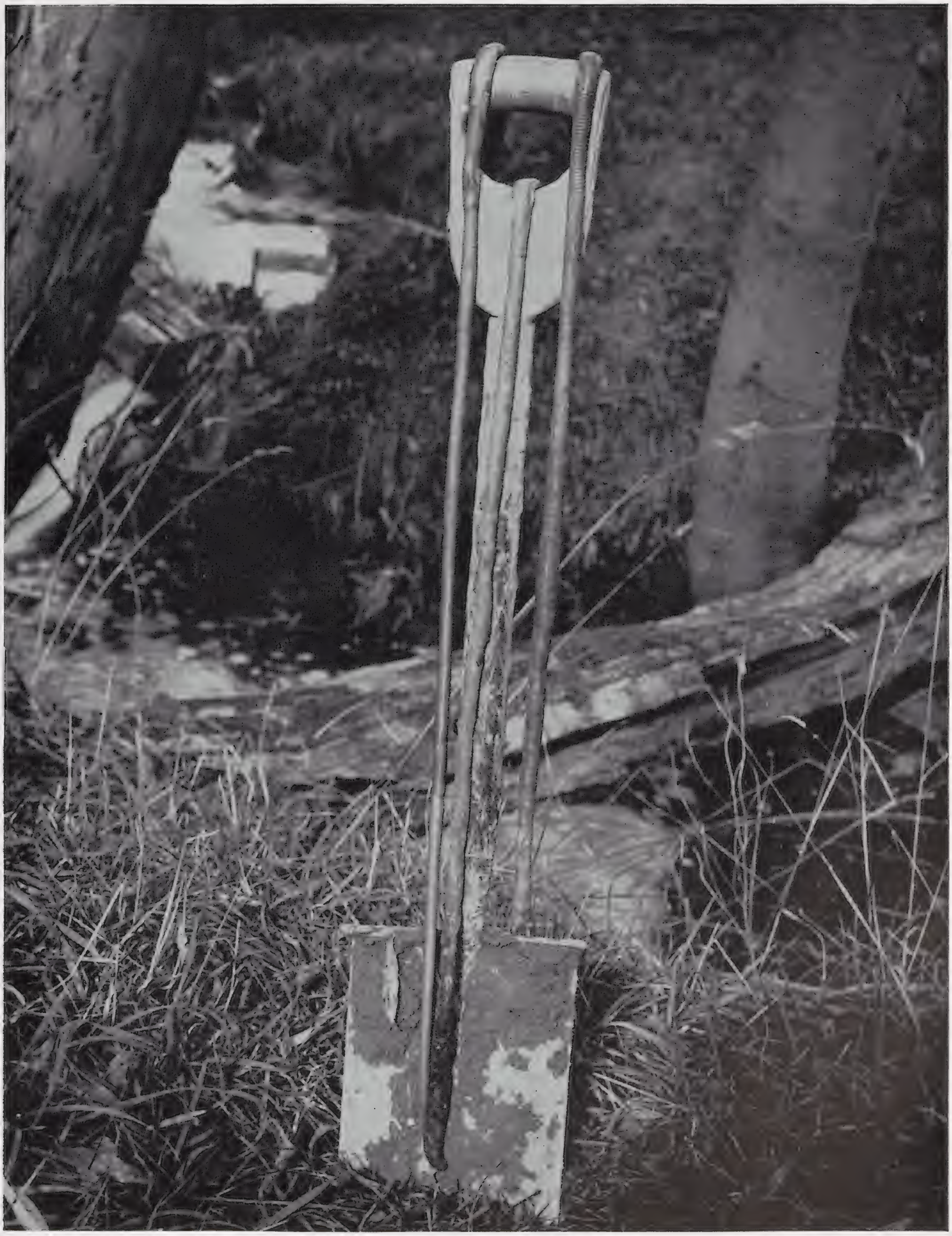
Extreme care has to be used in extracting the worms from their holes, once they have been uncovered, for they break apart easily. By careful handling and slow extraction, an inch or so at a time, the large specimens can frequently be pulled out of the ground without damage.

fresh, the eggs become dark brown. The young worm before "hatching," except in size, resembles the common earthworm of Europe.

Size is the giant earthworm's chief claim to distinction, though it presents structural peculiarities of special interest to the scientific zoologist. Its general habits are similar to those of ordinary earthworms: it burrows in damp clayey soil, swallowing the earth in front as it goes downward, and forming on the surface casts of the portion from which edible particles have been extracted. But the giant burrows very much deeper than lesser worms, and of course the burrows are larger, since its body is an inch or more in diameter. Outstretched on the grass, a giant earthworm might at a distance be mistaken for a length of garden hose.

There is nothing attractive in its appearance; in fact, it is a repulsive object to most people and from live specimens exhibited at a Nature Show I have seen both men and women turn away in disgust. But to the naturalist nothing in Nature is "unclean," and of days spent in the *Megascolides* country when specimens were dug out and handled, one has pleasant memories. I have made a special study of the giant earthworm and was instrumental in having specimens forwarded to the University of Edinburgh and several other overseas institutions. Recently I helped a Swedish scientist collect five specimens for his University. Requests have come from the United States. A Washington zoologist asked me to send him a number of *Mesgascolides* eggs in "cold storage" or slightly chilled. His idea was to hatch them and introduce the giant earthworm to North America! Impracticable, but an interesting proposition.

Living, this great worm emits a peculiar odor, resembling that of creosote. The body, with its 350 to 500 rings, (about 10 to the inch when the creature is extended; 14 when the body is contrated), is brittle, and it is not easy to secure perfect examples. Digging them out, one



This picture gives a good idea of the comparative size and length of the Australian giant earthworm. Three specimens are draped over the handle of the spade. Thirteen feet is probably the limit of the length they attain, and the author has seen them over eleven feet long.

usually cuts through more than are extracted whole for the burrows rarely are straight, and even with extreme care the spade often slices earthworm instead of a sod. One method is to locate a worm by hearing the loud gurgling sounds made as it contracts and expands, moving along the burrow, then carefully to dig until the hole is reached, perhaps a yard from the surface. Inch by inch the burrow is shortened, until a quick strong "dig" reveals a portion of the quarry. This is seized, but not roughly, and one tries to "ease" the worm from its slushy retreat. If the strain is too severe, the body breaks; experience has taught us to be gentle. Even so, there are casualties.

The kookaburra or laughing kingfisher (*Dacelo gigas*), the only bird known to eat giant earthworms, has its own method of extracting them from the burrows. Often the worms rest with about a foot of their head-end out in the open. Sighting one, the kookaburra darts from its perch in a nearby gumtree (Eucalypt), seizes the worm in its powerful beak and, bracing itself, begins to pull steadily, but not with a jerk. Soon it relaxes the tension, allowing the worm to extend and retreat a little; then the bird pulls again and gains an inch or two; the process is repeated, until one strong and sudden pull wins the tug of war for kookaburra. Not always, though; sometimes the earthworm escapes or breaks, so that its enemy secures only a small portion instead of the whole body.

This happens in autumn and winter time. During the hot summer months and in spells of very dry weather, the big worms keep deep down where there is moisture.

Contracted the giant earthworm measures from about 30 inches to 5 feet in length; fully extended, from 4 feet to 12 feet. I have seen many specimens exceeding 7 feet when extended, and a number about 2 feet longer. My record *Megascolides* was just over 10 feet. Mr. L. C. Cook, whose farm in the Bass River Valley has been visited by many naturalists, is our foremost authority on the giant earthworm, which abounds in the soil on a portion of his property. He regards 13 feet as the probable limit, and has actually seen specimens exceeding 11 feet in length when naturally extended. Most of the specimens in museums were collected by Mr. Cook and his son, Clem, both keen observers of wild life. They never fail to locate giants, but allow them to be taken only if needed for scientific purposes. A motion picture of "Megascolides at Home" was made on the Cook farm with father and son as the principal actors, apart from the giant earthworms. They are seen in the picture digging into burrows and extracting their reluctant tenants.

The large oval-shaped horny egg capsules are found loose in the soil or entangled among grass roots. Usually we come across several when digging out the worms, but I have not seen one in a burrow.

When a giant earthworm is cut in half, the two portions remain alive, moving vigorously for a considerable time. They bleed very freely and the blood is bright red. The fact that so many are mutilated, despite every care, makes us reluctant to dig for these worms, which rank among the animal wonders of Australia. Earthworms may seem strange objects for conservation efforts, but they need and deserve protection.

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All pictures not otherwise credited are from the photographic collecton of the New York Zoological Park and the Aquarium.

Notes from the Zoological Park and the Aquarium

For some reason that is a little hard to figure out, woodpeckers of whatever species have been unwilling to adapt themselves to life in the indoor flying cage in the Bird House. The experiment of keeping them there has been tried sevral times, and seldom with any conspicuous success. The most recent experiment, with three White-headed Woodpeckers (*Leuconerpes candidus*) from Brazil, has turned out to be an exception in the succession of failures, however.

The birds are really striking and unusual members of the woodpecker family. They are white, with the exception of black backs; even their eyes are white. This latter characteristic does not add to their beauty, incidentally, and gives them a rather sickly appearance. The distinguishing mark of the male is a pale yellow streak across the base of his neck.

Birds of such interest deserve the best quarters that can be found for them, but when they arrived the flying cage was the only place available. Logs of dead wood were set up in the cage and the birds were turned loose. For the first week or so all three woodpeckers refused to have anything to do with the logs and spent most of their time clinging to the wire sides of the cage. Orders were out to the keepers to catch them up and remove them from the flying cage when the trio got over their shyness and took to the logs, and since that time they appear to be thriving.

* * *

A tank of marine game fishes found in nearby waters is an exhibit at the Aquarium that is generally the center of a group of visitors exchanging stories of their own experiences with the various species exhibited. The tank contains Striped Bass, Bluefish, Jacks, Weakfish, Croakers, Spot, Porgies, Sea Bass and Flukes. The Striped Bass, Bluefish and Weakfish include specimens more than two feet long. The latter two were collected by the *Seahorse* in the summer of 1936 and apparently are going to be good for long exhibition.

* * *

Births in the Primate House are not uncommon occurrences, but comparatively few Macaque babies have been born here. The most recent arrived on February 25. A canvas screen was hung over the front of the cage for the first few days to give the mother and baby the necessary quiet and seclusion, and the active youngster is growing rapidly.

It is generally believed that monkeys born in captivity do not thrive, but there are several Rhesus monkeys in the Primate House collection that were born there, and now are half the size of their parents.

* * *

The first flight robin of the spring was seen in the Zoological Park on Monday, March 14, about ten days earlier than usual.

* * *

The Reptile House staff is awaiting with some dread the return of the Flickers to the Park. In previous years a Flicker has found the hollow metal cap of the Reptile House roof a wonderful sounding board for his courtship tattoo and has filled the building, for days at a time, with a noise that could hardly be rivaled except by riveters. Driven away from one side of the roof, the bird simply hopped over the ridge and started to work on the opposite side.

* * *

By recent action of the Executive Committee of the Board of Trustees, Dr. George M. Smith of the Department of Anatomy, Yale Medical School, was made Research Associate in Pathology at the Aquarium, and Dr. Homer W. Smith of the Department of Physiology at New York University-Bellevue Medical School, was made Research Associate in Physiology at the same institution. Several papers by them have appeared in *Zoologica* or the *Bulletin.*

* * *

The Park's collection of Dingos is beginning to rival its herd of Aoudads and Tahrs in rapidity of increase. The collection started with a pair of the Australian wild dogs acquired in the spring of 1932, and since then nine pups have been born, the latest accession being five (two males and three females) born on January 14 of this year. One pair has been shipped to the National Zoological Garden in Washington.

* * *

The young Olive Baboon, Tish, which attracted considerable attention recently when she was given a white rabbit as a playmate and cage companion during her earliest days in the Hospital, has been quartered with another juvenile inmate of the Hospital, a young chimpanzee. Both are being kept in the Hospital because suitable quarters are not available in the Primate House.

When they were first put together in the same cage, the chimpanzee was alarmed by the activity of the newcomer, and hid under a projecting shelf while the baboon explored every part of the cage. They quickly became used to each other, however, and now the baboon flies to the protection of the chimpanzee's arms when imaginary danger threatens.

* * *

The Okapi, received last August, has grown almost five inches in shoulder height since its arrival in the Zoological Park.

* * *

In response to a request from an official at Sing-Sing for assistance and guidance in setting up some tanks of small tropical fish for inmates of the prison who were interested in aquatic life, the Aquarium undertook to collect and install four fifteen-gallon tanks of "tropicals," and to provide the prison library with a small collection of books and magazines about the maintenance of such aquaria. Various commercial dealers in tropical fish contributed the equipment and the Aquarium supplied the library out of duplicate publications in its own files.

* * *

Acting Director Breder of the Aquarium returned in mid-March from a month's trip to Florida and Cuba to visit aquariums and ichthyologists.

PUBLICATION OF INTEREST

OCEANIC BIRDS OF SOUTH AMERICA. By Robert Cushman Murphy. 2 vols. The American Museum of Natural History. $10.50.

The author of this work (there are two large volumes) has been awarded the Brewster Medal of the American Ornithologists Union "as the most important work relating . . . to the birds of the Western Hemisphere that has appeared during the six year period" since the last award. The Ornithologists Union might well have omitted the time limits and area—the book is in a class by itself.

It came with the author's inscription "To one Old Salt from another." Well, we were both afloat long enough for much observation of sea birds. I studied it many evenings and tried taking it to bed, but its influence was anything but soporific. My interest in sea birds, long dormant, reawakened. A kindly fate had, long before, sent me to sea on ten years of voyages with the *Albatross.* I had sailed both sides of South America as well as more distant seas, always observing sea birds, but here were set forth the detailed studies of an ornithologist, on birds I knew only superficially. On many voyages I carried lists of museum desiderata supplied by Ridgeway. The *Albatross* was perpetually stopping for deep sea sounding and dredging, which permitted the lowering of a boat to pick up petrels and other oceanic wanderers. There were calls at uninhabited islands where seafowl swarmed. The ship also made long zigzags far seawards for investigation of the profound depths. Here were none but real *oceanic* birds.

Ten years ago a pocket-sized book, *Birds of the Ocean,* appeared which revived my interest, but Murphy's big book was a heart warmer. For years I had seen little of sea birds other than the penguins, cormorants and pelicans we brought to the Aquarium. Most sea birds don't thrive indoors and we kept only the hardy kinds.

With "Oceanic Birds" I began a post-graduate course. The enterprising collector of over forty years ago plunged into the real *ornithology* of the subject. What an outlook on the bird life of the sea there would have been had the library of the *Albatross* contained such a book.

I had seen cape pigeons, wandering albatrosses, jaegers and steamer ducks and even collected them, but knew little about their lives. I had previously collected three or four thousand land birds in North and Central America and might have developed into an ornithologist had not other duties pressed upon me. The mysterious birds of the open sea became increasingly interesting. After such experiences, this masterly work naturally compelled study. The *Albatross* had sailed the Humboldt Current where Murphy made interesting studies of sea birds, but I had not seen South Georgia and the mid-Atlantic islands where he found so much that was new to naturalists. My own experiences with birds at sea are referred to merely as understandingly sympathetic with the greater ones of the author.

Many pages are devoted to the remarkably efficient ornithological field work of Rollo Beck, whose unparalleled collections from all around South America form much of the material so critically studied and so masterfully presented by the author. It is doubtful if any field naturalist ever matched the work of Beck either in numbers of specimens or their quality as museum material.

The field work of the author in far-away South Georgia, the Chincha Islands and during the voyagings of the whaler *Daisy;* the work in South America conducted by Dr. Chapman and his associates and that of others are set forth in detail. The rest of Part 1 is climatological, geographical, oceanographical, meteorological, hydrographical and generally distributional as concerns sea birds. These matters are scientifically and convincingly set forth and are indispensable to a clear understanding of the distribution of the nearly 200 kinds of sea birds known to this comparatively limited section of the globe.

There are thirty pages of bibliography and more of index.

The sixteen color plates by Jaques, many of them painted from life on the west coast of South America, are very attractive. There are over seventy halftone plates from good photographs and many text figures.

I find nothing to criticize except possibly the "heft"—one volume laid on the scales, weighed five pounds. The present edition is limited to 1,200 copies.

It is to be hoped that the author will undertake further work on sea birds. He has made us better acquainted with birds of far southern seas, such as penguins, but there are the auks and murres, as essentially far northern birds as the penguins are southern. He would be fascinated with the bird islands of Bering Sea and the north Pacific ocean.

Wouldn't I like to pilot him on the Pribilofs and to the sea-bird cliffs of the Aleutian Islands!

The writer has not attempted an ornithological *review* of this monumental work on Oceanic Birds —let us call it simply An Appreciation.

—C. H. TOWNSEND

Serpents of the Northeastern States

By Raymond L. Ditmars

HERE is a comprehensive, yet compact, book about the snakes of the northeastern states that will prove to be extremely useful to everyone with a summer home or camp in that region. This guide to the venomous and non-venomous reptiles of the New England area, New York, New Jersey and eastern Pennsylvania, is a practical and handy reference work. It gives a key for ready identification of snakes, descriptions of their feeding and breeding habits, notes on distribution and photographs of every species found in the northeastern states, including color plates of the copperhead and rattlesnake. One section is devoted to the emergency treatment of snakebite.

"Serpents of the Northeastern States" was originally published as a complete number of the Bulletin and several reprintings were quickly exhausted. It has been republished in a new format, somewhat revised as to text and nomenclature, and four photographs have been added.

60 pages, 41 illustrations. *50 cents postpaid.*

Department of Publication & Photography
NEW YORK ZOOLOGICAL PARK
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New York, N. Y.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Forty volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XXII are complete and indexed. Volume XXIII will be issued during 1938, in quarterly parts. *Zoologica* is sent to members on request.

[*Zoopathologica,* Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica.* *Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report, Zoologica* and *Zoopathologica,* as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. Mitchell, *Manager, Zoological Park,* 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

Clark and Fritts, New York, Printers.

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XLI, No. 3 May-June, 1938

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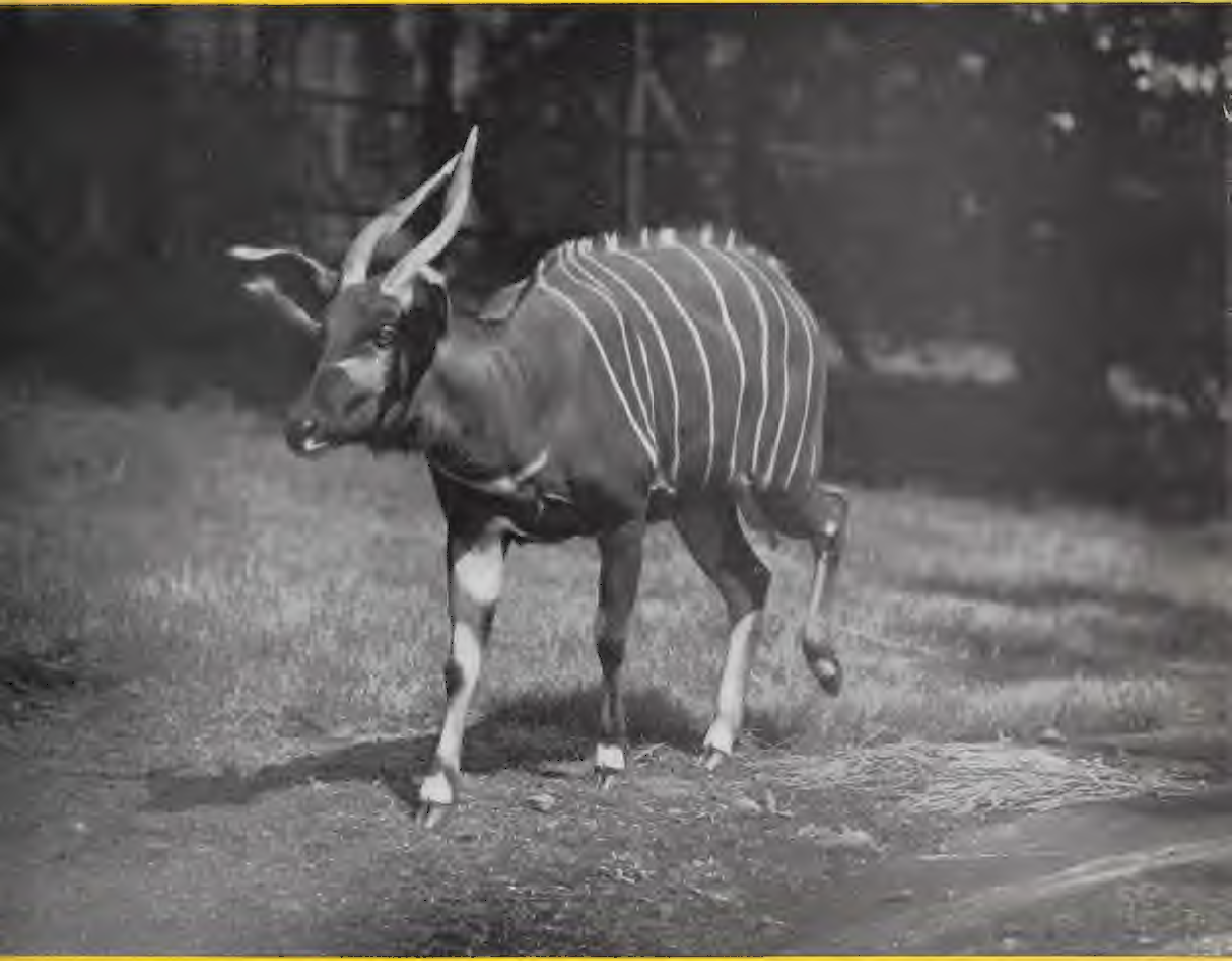

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

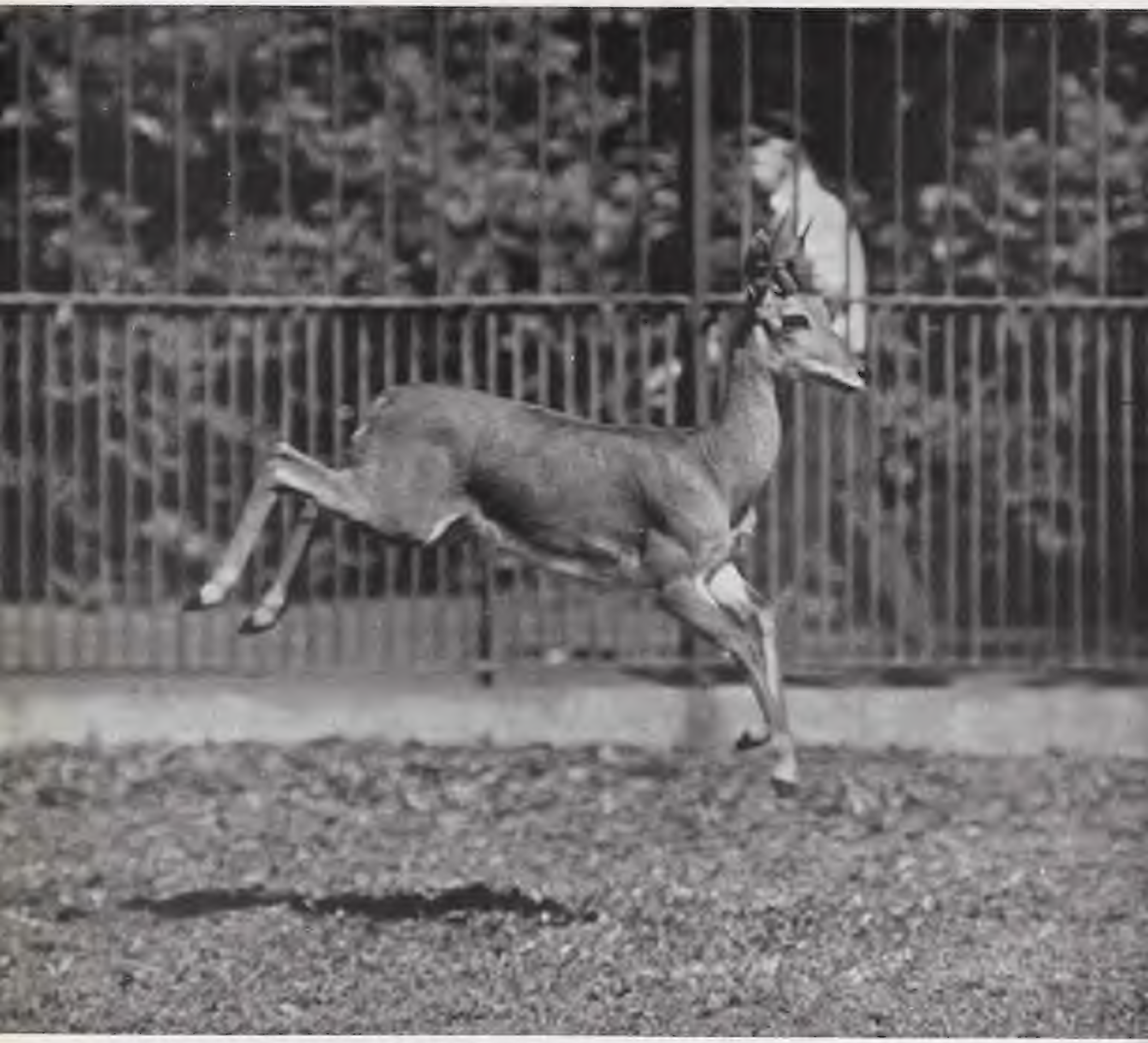
Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



CHANLER'S MOUNTAIN REEDBUCK IN A BOUNDING TOUR OF HIS CORRAL

BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

Published by the New York Zoological Society

Vol. XLI May-June, 1938 No. 3

Antelopes in Retrospect

A Review of the Forty Species or Races that Have Been Seen in the Collection at the New York Zoological Park

Claude W. Leister

THE Antelope House at the New York Zoological Park was first opened to the public on October 17, 1903. At that time its twenty-two compartments with outside corrals offered the best and most modern quarters then available for housing representative species of the world's antelopes. A year after opening day found these facilities comfortably utilized by fourteen species of antelopes to a total of twenty-two specimens. At this writing we have on exhibition seventeen species including twenty-seven specimens. Then, as now, we had two giraffes but, in addition, our present collection also includes the okapi, then an almost mythical animal not yet seen by a white man. Although housed with the antelopes, these animals are not included in either of the above accountings. Our elands, because of their size, were never quartered in the Antelope House but have always been placed with the cattle along South Walk, near the Boston Road Entrance.

Thirty-five years ago the Antelope House seemed to be a thoroughly adequate structure, big enough to take care of all future needs. But the end of its first year found it working almost to capacity. Some of the world's rarest antelopes began to trickle into the collection. Exhibited for the first time in this country, the requirements of many of these animals were practically unknown. Some of them lived for only a short time, others survived well beyond our best expectations. Now we know fairly well what animals can be expected to thrive under our conditions.

It is generally easier to obtain specimens today than was the case during the early history of the Zoological Park. In more recent years steamship connections with South and East Africa have vastly improved. Today, if we make a real effort to secure an animal, it usually can be sent on its way to New York within a reasonable length of time. Likewise, with improved accommodations and a shorter time en route, its chances of surviving the trip in good condition are much better.

As Dr. Hornaday stated in his guide book to the collection, "In the Antelope House the visitor to the Zoological Park will observe the results of the Zoological Society's continuous efforts to maintain a good line of samples of these wonderful animals." We cannot do better than that. Although we do not find a single representative native to America, all told there are some 170 species of antelopes confined to Africa, with an additional handful in southern and central Asia. A sample of these numerous species is all we can hope to exhibit for the visiting public.

While, sometimes, there may be a marked change in the collection from day to day, it remains much the same from year to year. Some antelopes are not readily obtainable and hence may be held for sale at an exorbitant price. But, fortunately, representative species can usu-

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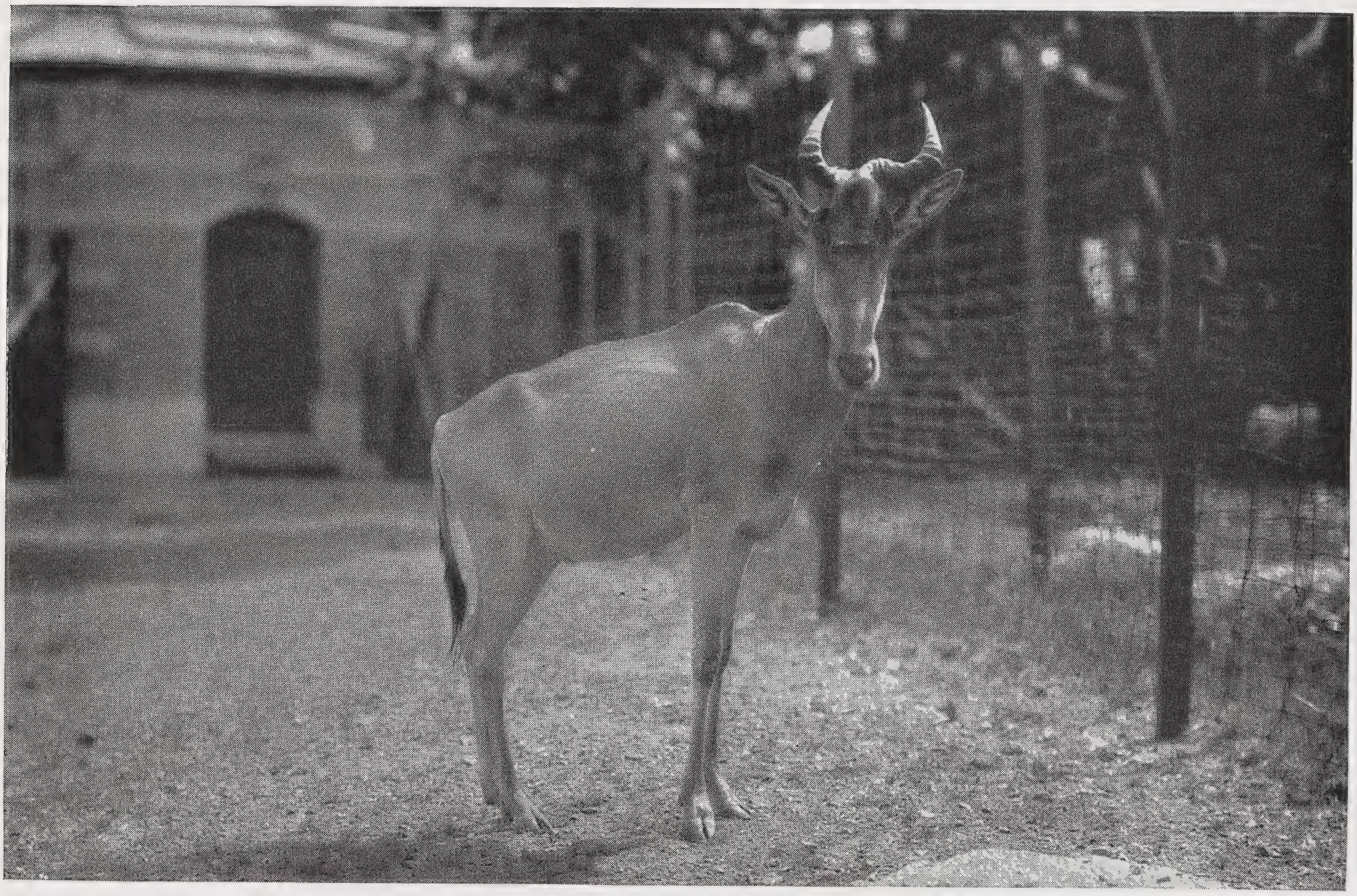


The hartebeests are easily recognizable because of their doubly curved horns and their exaggerated cow-faces, which are unusually long and narrow. This is the lelwel hartebeest, the only species of this comparatively rare animal that we have exhibited.

ally be obtained at not too great a cost and in a comparatively short time. Thus, while the loss of some particular animal may cause a temporary gap in the collection, as a rule it can soon be filled.

The following pages call attention to the antelopes comprising the really fine series that has been exhibited at the Zoological Park.

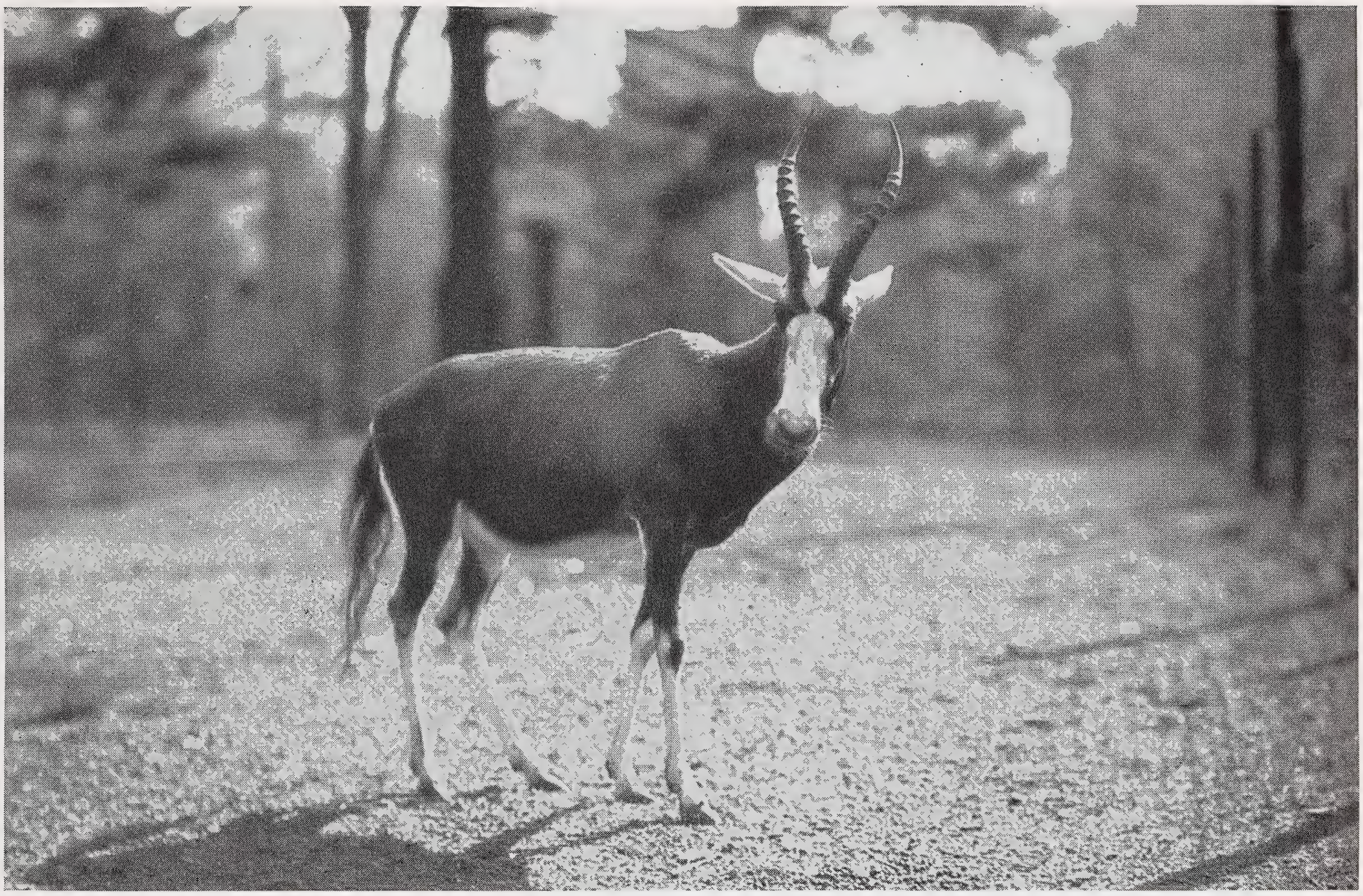
Individual specimens possess distinct personalities and many of our first animals are clearly remembered by older members of the staff. We, too, will always remember outstanding specimens of our time.

Even the casual visitor to the zoo can easily recognize the hartebeest by its exaggerated cow-face and doubly curved horns. The frontal bones of the skull are considerably lengthened to form a pedicle for the support of the horns. The face is thereby made extraordinarily long and narrow. All of the included species are so generally clumsy, as well as homely, that they have good exhibition value. In recent years few hartebeests have reached this country and they are generally rare in American collections. We have exhibited one species only, the lelwel hartebeest from Kordofan.

A closely allied group of antelopes (*Damaliscus*), contains a half dozen fairly well-known species. They are not quite so ungainly as the true hartebeests, the skull is not prolonged into a pedicle and the horns have a single curve. From this group we have exhibited the tiang, blesbok and bontebok.

The tiang and topi are now regarded as races of the korrigum (*Damaliscus k. korrigum*). All are medium-sized, reddish-brown antelopes with a black blaze on the face and black areas on shoulders, hips and thighs. The korrigum is native to West Africa, the tiang and topi are East African.

The two best-known members of the *Damaliscus* group are the remarkably similar blesbok and bontebok. They are characterized principally by a white blaze on the face and white lower legs. The bontebok has the white blaze on the face, narrowed considerably between the



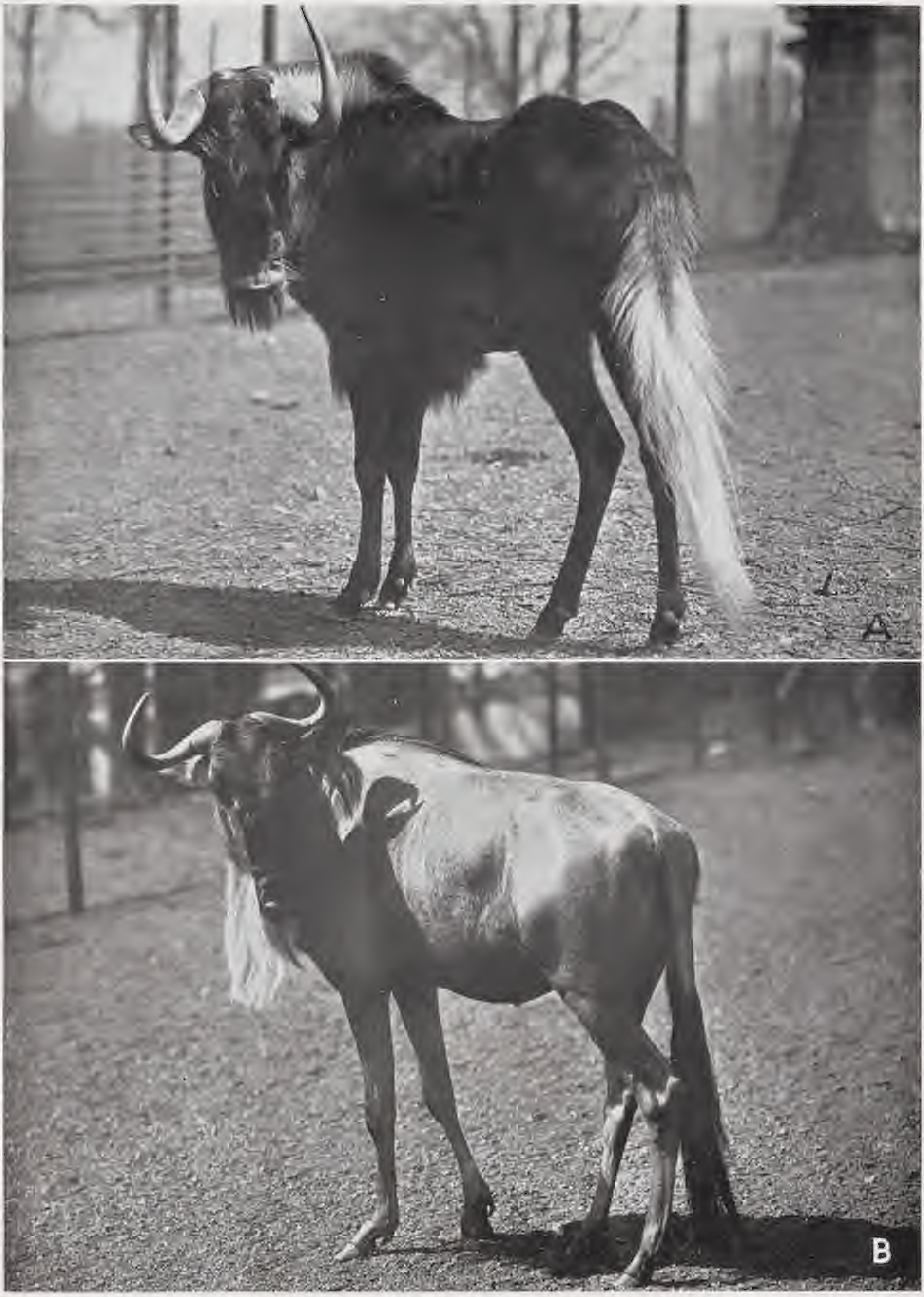
The bontebok and the blesbok are so nearly alike that it is very easy to confuse them. This is the bontebok, as may be most readily identified in this picture by the fact that the white blaze on its face is not entirely separated into two parts.

eyes but not divided into two parts. The posterior part of the rump and the base of the tail are white. The blesbok has the white blaze on the face divided into two parts by a narrow brown area between the eyes, and the posterior rump and the base of the tail are a light brown instead of white. Because of their general similarity and an early inclusion under the same name, these two antelopes have been frequently confused. The bontebok was first given the name *pygarga,* while the blesbok, with its darker face, retains the name *albifrons,* originally given to these animals when the species were undifferentiated. The blesbok holds its own fairly well on the African plains but the bontebok is now rare in a wild state and is seldom found in captivity.

Next to the hartebeests the strangest looking antelopes are the gnus. They are rather horselike in general appearance, with horns shaped like those of the buffalo. A closer inspection reveals peculiar hair bunches on chin and nose and the oddly flattened nostrils. They are good exhibition animals.

Gnus have long held the reputation of being the madmen of the antelope world. From the amount of perversity and downright viciousness which they sometimes bring into captivity we can easily believe that this notoriety is well deserved. A white-tailed gnu of former years was the terror of the Antelope House and in his time furnished plenty of work for carpenters, iron workers and plumbers. When he finally died of old age his horns were worn down to mere stumps. In his younger days the height of his ambition seemed to be the murder of his keeper. To see what he could accomplish in this respect, a discarded uniform coat was stuffed with hay and placed within his enclosure. The gnu went to work on this improvised dummy with horns, teeth and heels, with such thoroughness that there was no doubt at all in the minds of the observers what he would do to the keeper if he ever got the chance.

Our present brindled gnus, mother and daughter, are extremely jealous of each other. Life with them is a continual push, bunt and pummel, shared with never-failing impartiality.



The gnus (A, white-tailed; B, white-bearded) are savage in appearance, and are generally so in actuality. Their keeper must constantly be on his guard against a vicious hook by their sharp, curved horns. The brindled gnus in the collection at present are a mother and daughter, who are jealous of each other and often fight.

The smaller African antelopes, including the duikers, dik-diks, oribis, sunis and steinboks, while interesting from a zoological standpoint, do not have much appeal for the average visitor to the zoo. But an effort is made to keep several species on exhibition, if merely to illustrate the size of these animals. All of the above are confined to Africa. Many of the included species are about the size of hares and seem to take the place of those animals in nature's scheme of things. The smallest in this group, in fact the smallest of all antelopes, is the royal antelope, standing about ten inches at the shoulder.

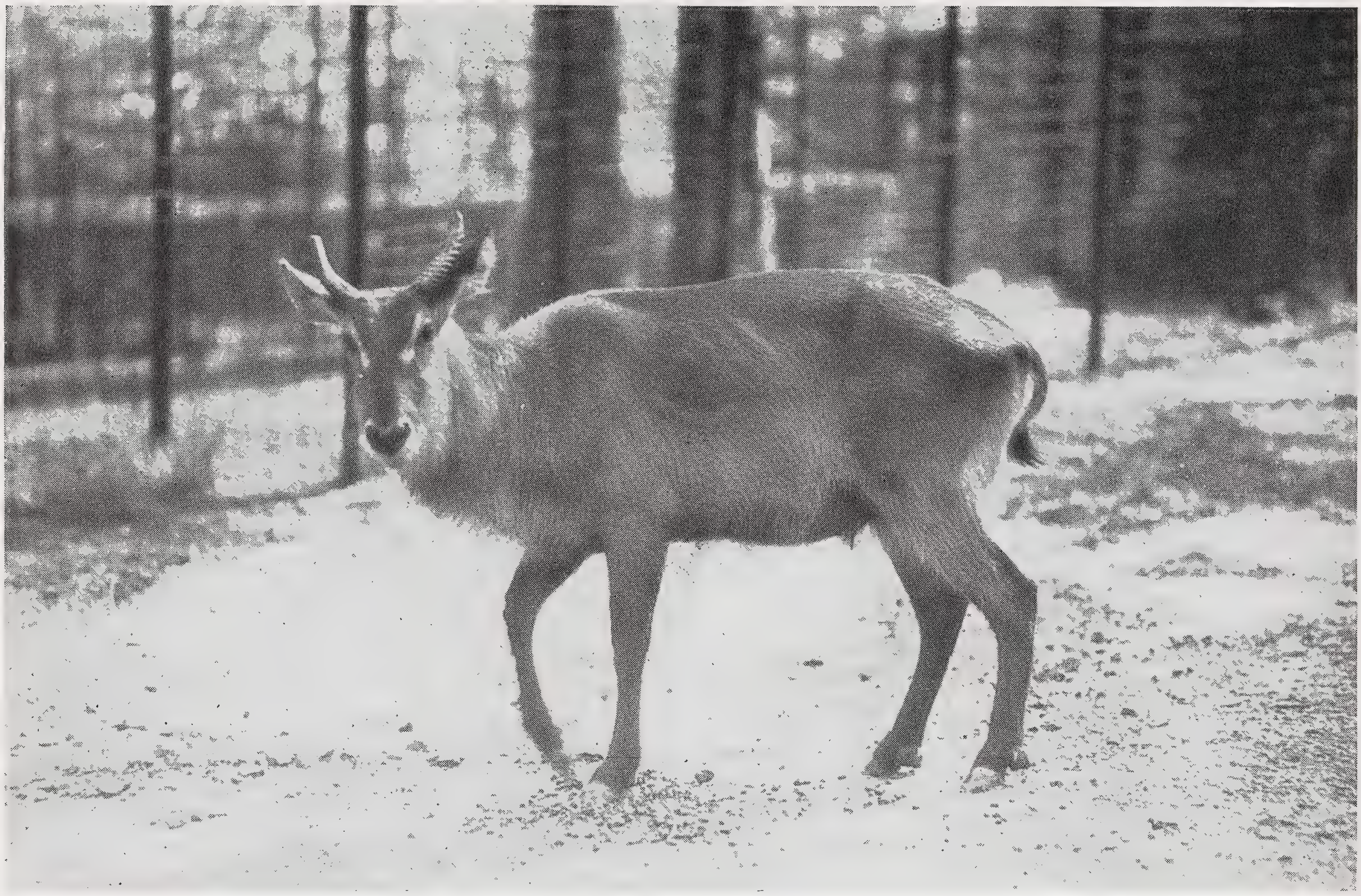
Some of the duikers, especially such as Jentink's, the yellow-backed and the banded duikers, are beautiful little creatures and well worth showing, but they have the reputation of never living for any length of time in captivity, especially when caught full grown. We have never exhibited any of these species.

While most of the smaller African antelopes are confined to comparatively open country and grasslands, the klipspringer is found in rocky and even mountainous regions. With amazing agility it makes its way over seemingly unscalable cliffs and along apparently inaccessible ledges. It is the chamois of South and East Africa.

Representative species of the waterbucks and their smaller allies, the kobs, are necessary to round out any collection of antelopes. The majority of included species do well and in fact many will breed in captivity. On the other hand, a number of them are rareties in zoological collections, since they are difficult to obtain in the wild and the cost of transporting them to foreign zoos is sometimes much too great. Zoological parks are seldom able to exhibit more than a few of these allied species at the same time.

The average visitor, and the zoologist too, for that matter, sometimes finds it difficult to distinguish the different groups and species. The typical waterbuck (*Kobus ellipsiprimnus*) possesses a white, elliptical ring or "ribbon" across the rump and extending to the thighs. The sing sing waterbuck (*K. defassa*) has a large white patch on the lower part of the buttocks. The males of both these waterbucks possess heavy

These are two full-grown specimens of the duiker antelope—a representative of the group of diminutive antelopes that seem to have replaced hares in Nature's scheme in certain parts of Africa. The smallest is the royal antelope, standing about 10 *inches at the shoulder.*



We have had excellent success in maintaining the sing sing waterbuck in our collection, and several specimens bred here have been disposed of to other zoos. The males carry heavy horns that are ringed almost to the tips, while the females of the various species are hornless.

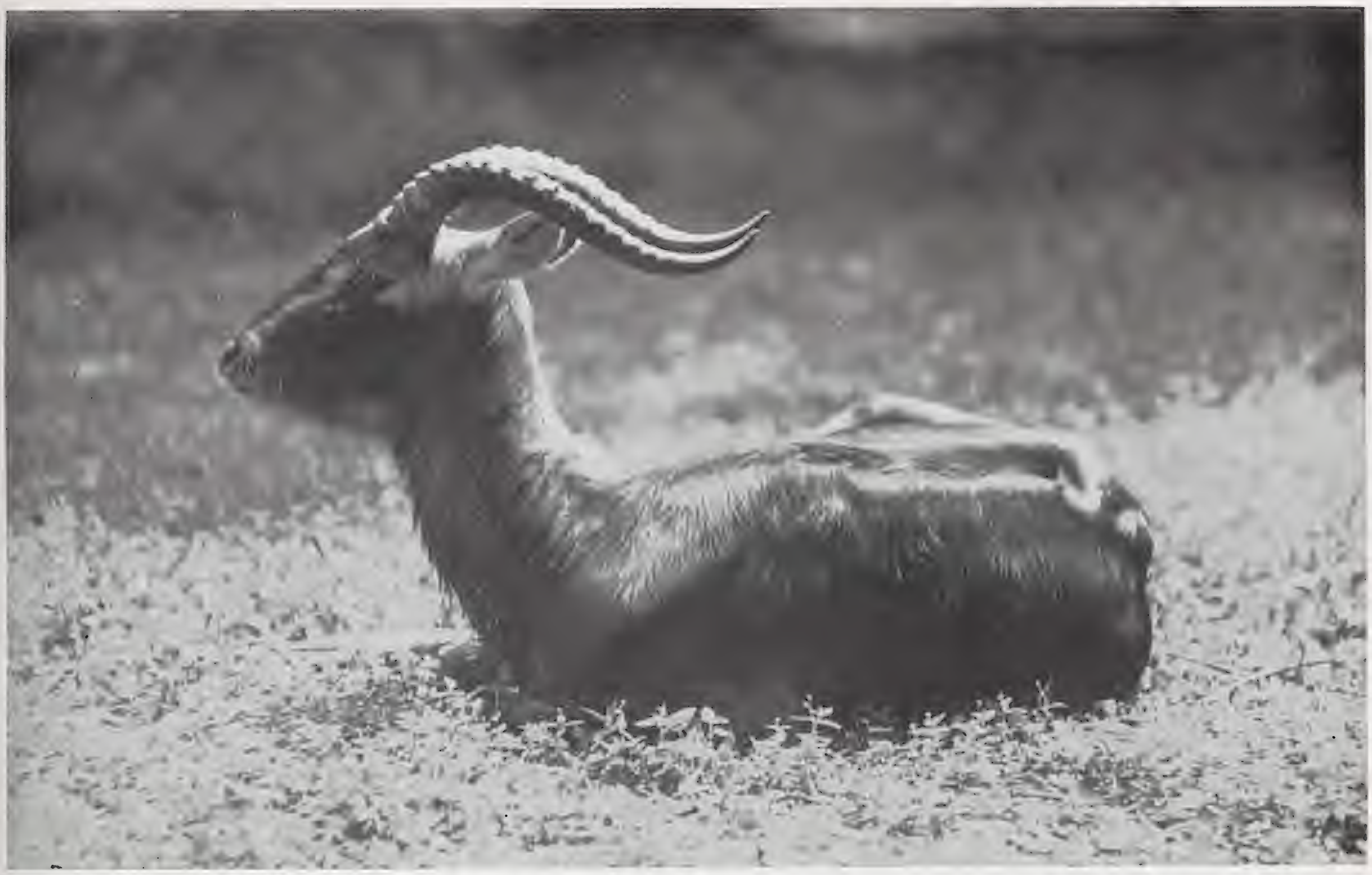
horns, ringed almost to the tips. The females of these and allied species are hornless. The sing sing waterbuck or defassa has been a hardy species here at New York, where our present animals have bred freely and furnished several specimens for other zoos.

The lechwes are most like the true waterbucks and we have exhibited several species. The Nile lechwe, or Mrs. Gray's waterbuck, is perhaps the most handsome animal in these allied groups. Our collection suffered a distinct loss when our last Mrs. Gray's died three years ago. The males are blackish brown in color, with a large, whitish patch above and forward of the shoulders. The ears are whitish. The females are chestnut in color. The horns sweep backward over the shoulder in a graceful double curve.

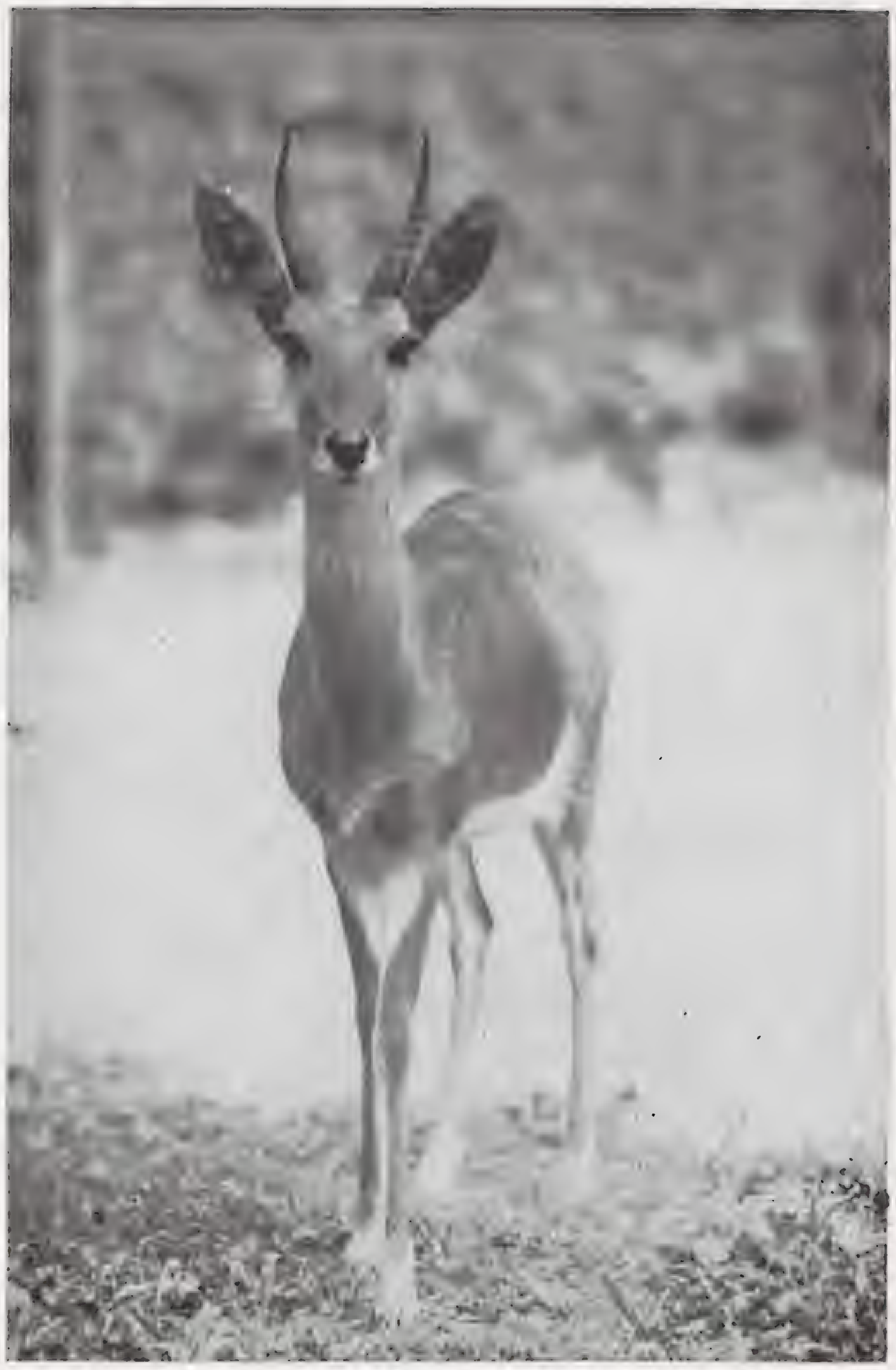
Like the waterbucks, lechwes are most abundant in the vicinity of rivers, swamps and lagoons. The lechwe was discovered by the explorer Livingstone in 1849. Mrs. Gray's lechwe has an equally interesting history. The first specimen was received in England in 1849, when it was described by Dr. John Gray of the British Museum, who named the new waterbuck *Cobus maria,* in honor of his wife. It went under that name for some years, until it was found that the name *maria* had been superseded by the currently-used *megaceros,* of Heuglin, who brought the first specimens to Vienna in 1854. There are several other well-marked races of the lechwe which we have never exhibited.

None of the kobs (*Adenota*) came to our collection until about three years ago when we received a young pair of the white-eared race. Kobs are notably difficult to tell apart, especially without comparative material. Young specimens differ greatly from the adults. Only now is our male white-eared kob approaching the typical, dark, blackish-brown color of the old males, with white ears and a white ring around each eye.

The vaal rhebok has never been exhibited in the Zoological Park. In spite of the fact that it is rather small, being only about thirty inches high at the shoulder, it should prove to be an interesting animal from an exhibition standpoint. It remains on our "want" list.



"Mrs. Gray's waterbuck" is the rather unusual common name of the species above, which is considered the handsomest of the waterbucks. We now have a pair of Chanler's mountain reedbuck, or rooi rhebok, pictured at the right.



The typical reedbucks (*Redunca*) have not been represented in our collection during recent years. Although about the same size as the waterbucks they are lighter in build and the more slender horns flare outward. All in all, they are more graceful animals.

Chanler's mountain reedbuck, the northern representative of the rooi rhebok of the Boers, was new to our collection when received two years ago. Since then we have purchased a female. The pair has proved to be a delightful surprise in that they possess an unexpected grace and agility which they show in frequent bounding jaunts about their corral.

Several other species, closely related to the reedbucks, include the bohor reedbucks, dibatag and the impalas. Any of these would make interesting additions to our collection and all will be found on our list of desirables. Unfortunately they are seldom imported.

The saiga, that curious, sheep-like antelope with the big, puffy nose, was never exhibited in this country until a few years ago when a group of three animals arrived in New York. Our present specimen, a fine male, gets his full share of attention from visitors. His best drawing card is his enormous nose, certain to catch the eye. In addition, he is an inveterate beggar and with grunts and stamping feet impatiently demands his tribute from the passing crowd.

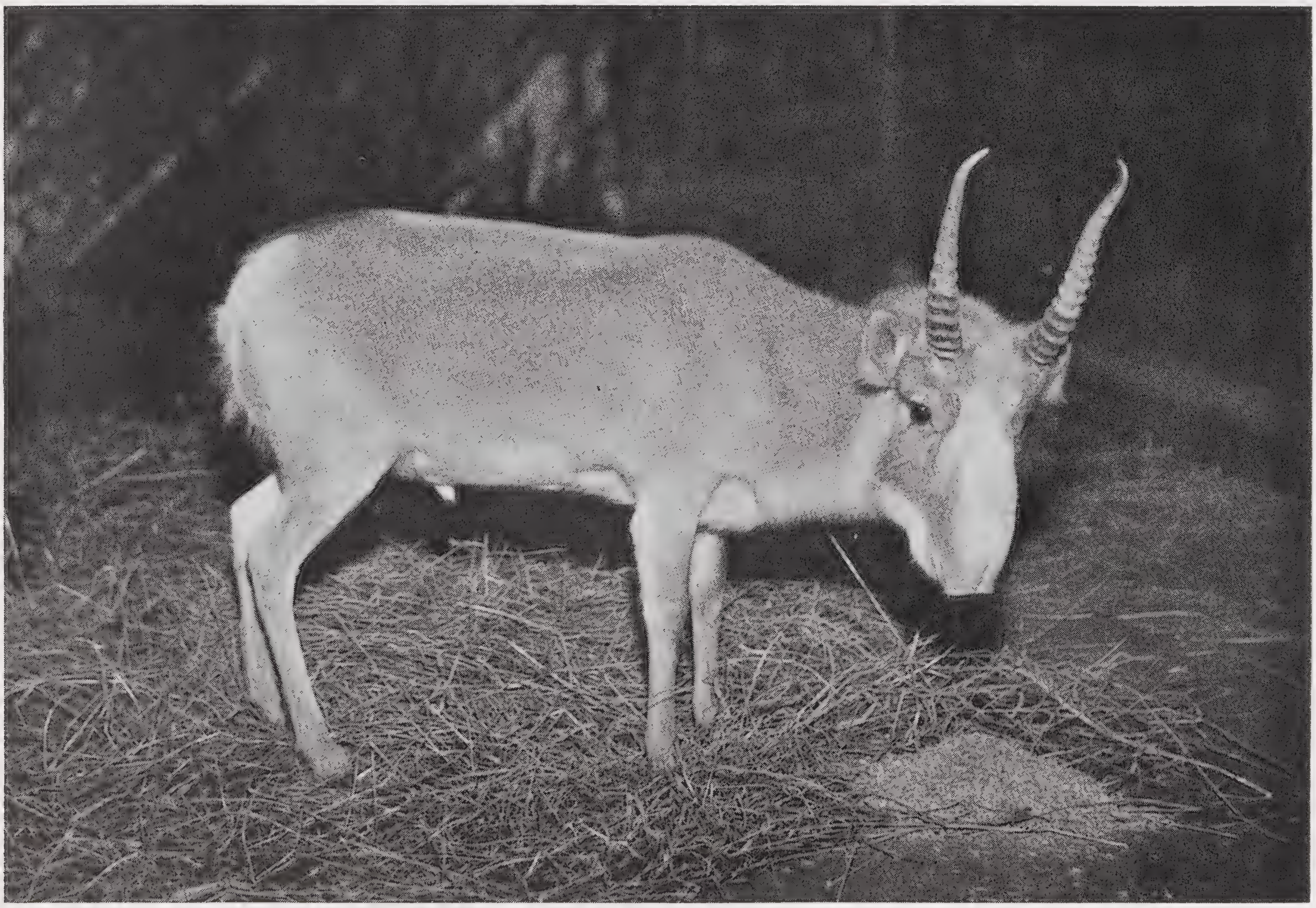
The handsome Indian blackbuck commands interest in any antelope collection. No hoofed animal bears a more beautiful or a more perfectly turned pair of spirally-twisted horns. It does well in captivity and a herd, once started, will keep going for years. As in many other antelopes, the dark, almost black color of the old males is acquired gradually as the animal ages. Our blackbucks are housed in the Small Deer House.

It is impossible to exhibit at any one time more than a few of the many species of gazelles. Since some of them inhabit isolated arid and even desert areas of the world, many of these species are seldom seen in captivity. Those native to the Arabian desert area are especially rare in American collections.

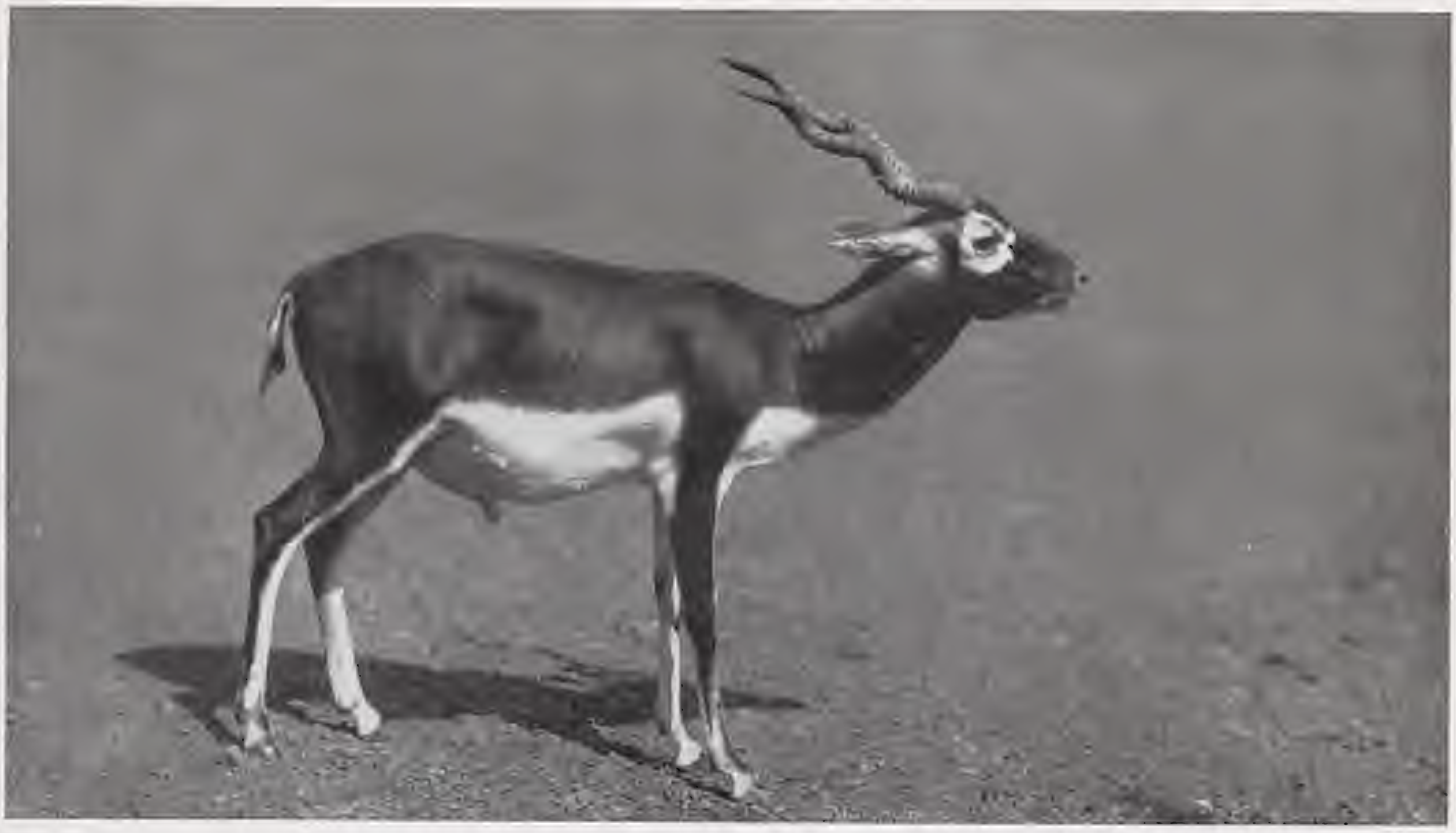
"As graceful as a gazelle" has been such an overworked simile for so long that the average visitor to the zoo is more or less disappointed when he sees his first gazelle. It is true, however, that under the usual restrictions of captivity the majority of these animals are not at their best. Seen on an open plain the gazelle does not belie its reputation.

Gazelles are medium-sized antelopes and most species average around twenty-two to twenty-seven inches in height at the shoulder. The largest in the group is the addra which reaches a full thirty-six inches. This handsome gazelle, gentle and tame, has long been a feature of our collection.

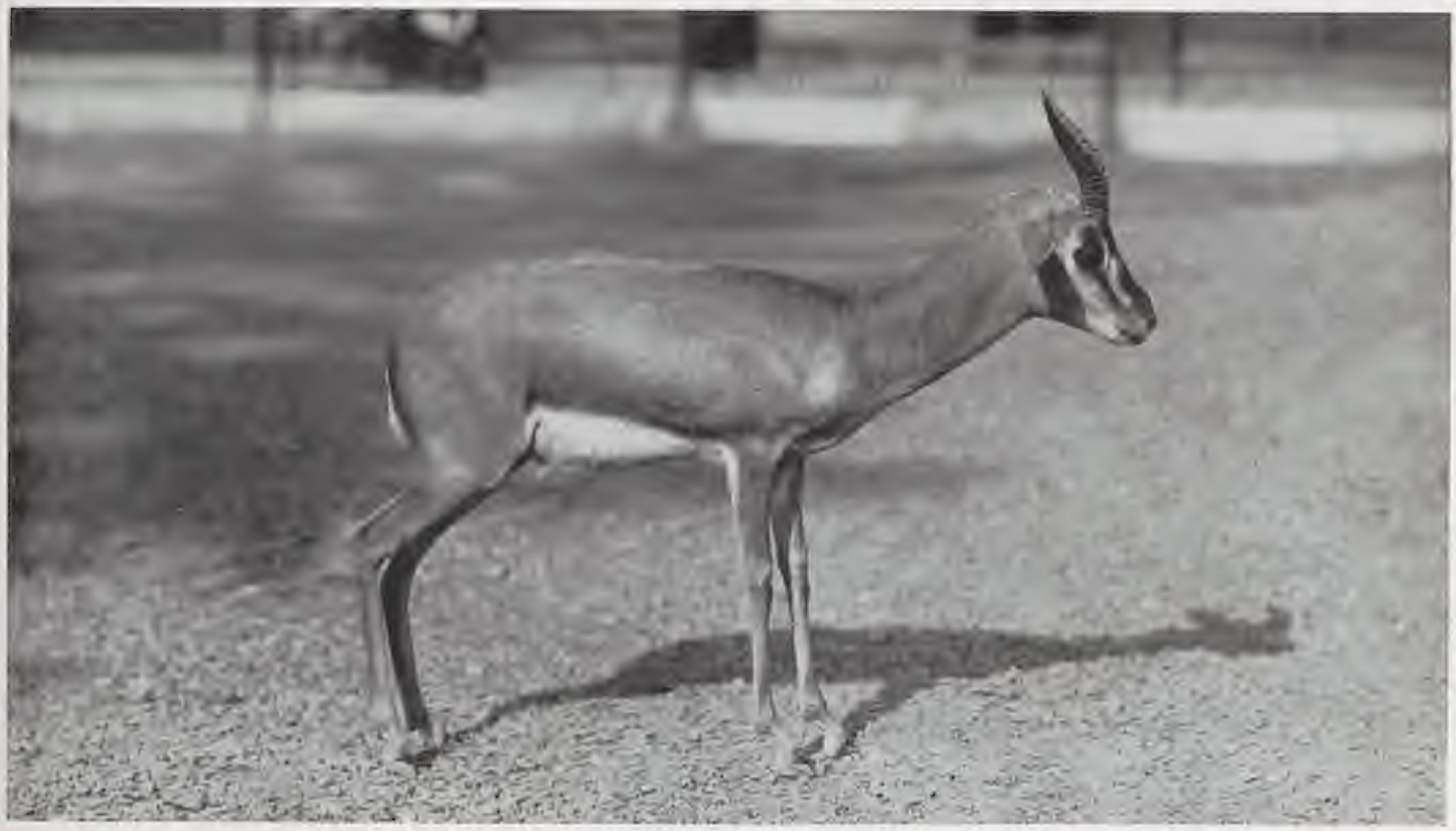
While we have exhibited several of the rarer gazelles, strangely enough, two common East African species, Thomson's gazelle and Grant's gazelle, have never been represented. Grant's gazelle stands about thirty-five inches at the



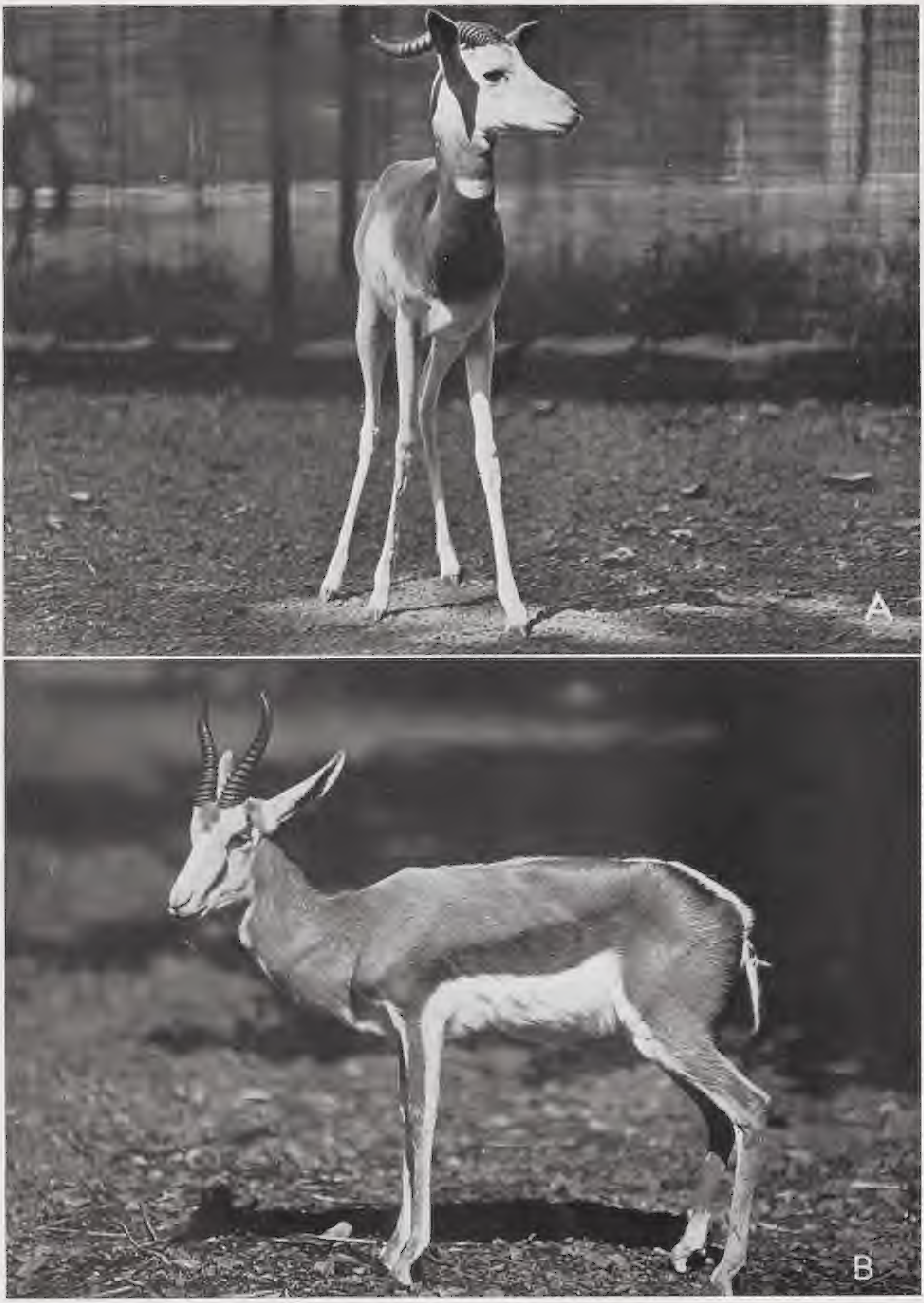
The saiga from the cold steppes of Siberia is a true antelope, although in some ways it rather resembles a sheep. Its most remarkable feature is its huge, puffy nose. In the spring the animal sheds much of its thick coat and consequently appears considerably smaller in size.



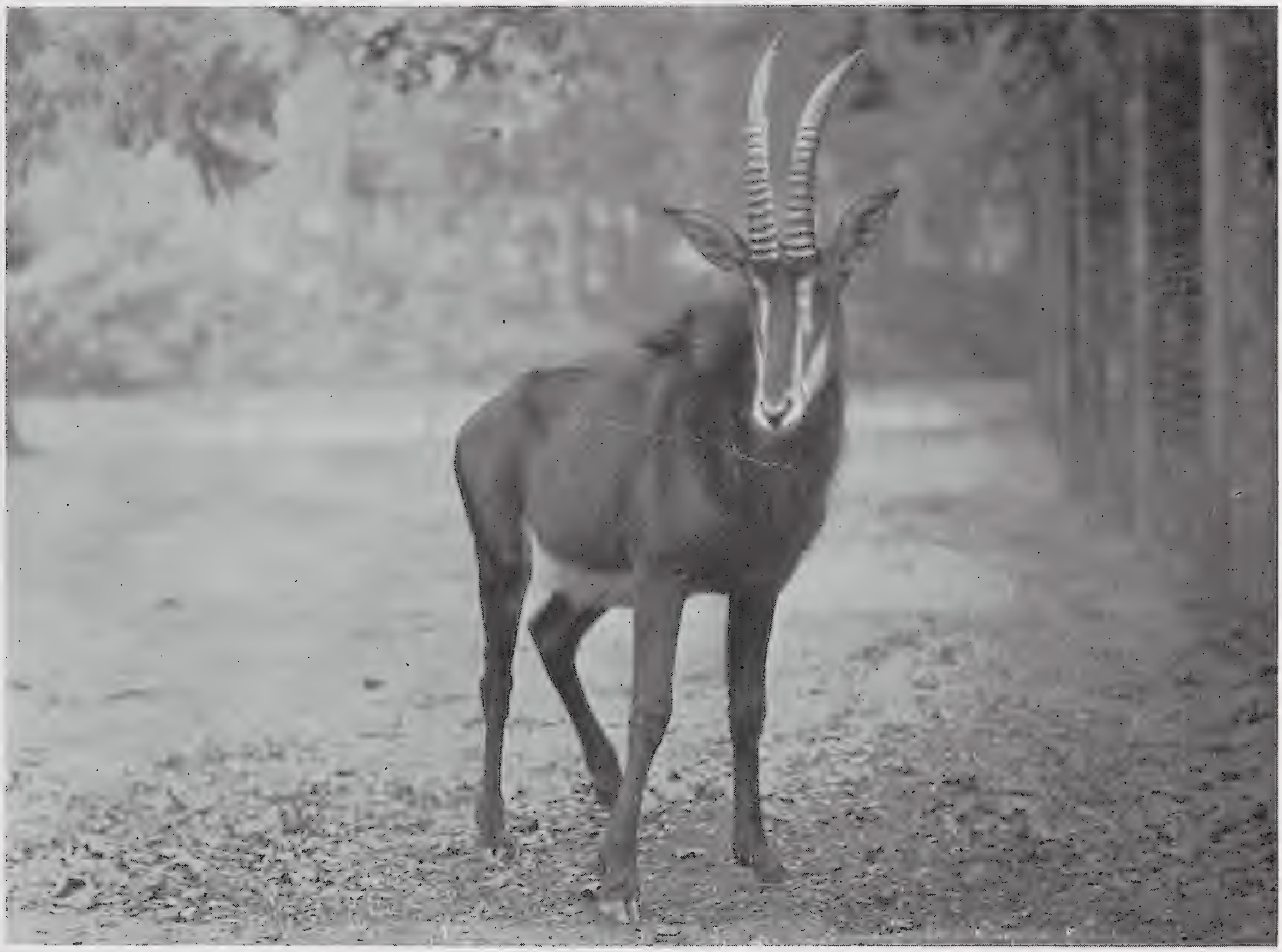
Although not of great size, the Indian blackbuck is sufficiently handsome to command attention in any collection of antelopes. Its chief claim to beauty lies in its perfectly turned and spirally twisted pair of horns, which are certainly not surpassed by any hoofed animal. The color of the old males darkens with age, until very old specimens are almost black.



Gazelles are popularly supposed to be both graceful and gentle. Under natural conditions they are certainly the former, but experience in the Zoological Park has made it doubtful if the latter term can be applied to the Dorcas gazelle, at least. There are many species of gazelles, and we have exhibited several of the species less commonly seen.



(A) The addra is the largest of the gazelles and this particular specimen, gentle and tame, has long been a favorite in our antelope collection. (B) The South African springbok is one of the most active of all the antelopes, and frequently indulges in wild, plunging leaps about its large outside corral.



The massive horns and the large, finely-shaped head of the sable antelope make it a trophy keenly sought by hunters of African big game. The dark reddish-brown coat of the animal and its large size make it a distinctive addition to any collection of antelopes.

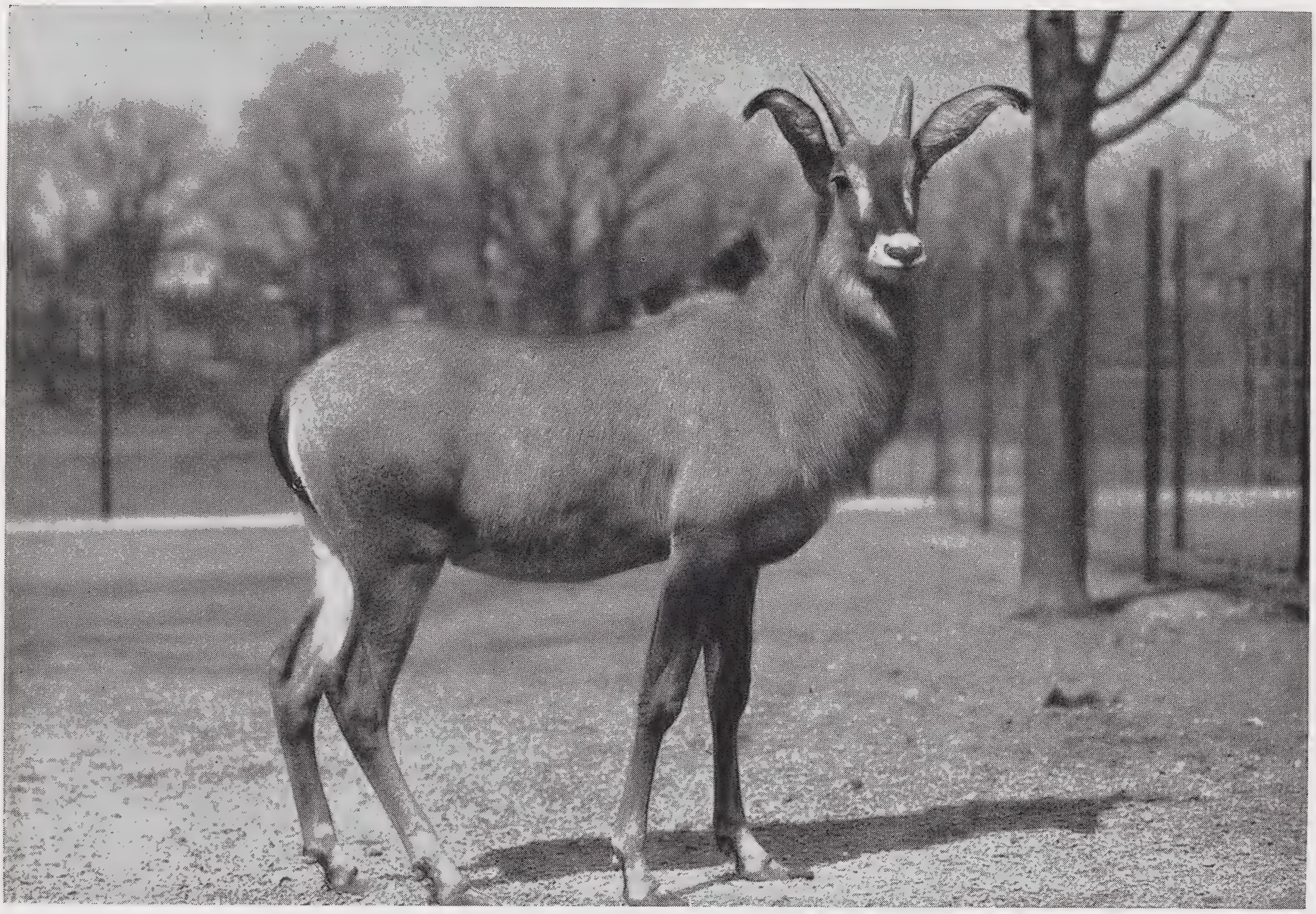
shoulder. The relatively large and graceful horns are excellent trophies of the chase and have been sought by practically every hunter of African big game.

Closely related to the true gazelles is the interesting gerenuk or giraffe antelope (*Lithocranius walleri*), from East Africa. This long-legged, long-necked antelope is a browser, subsisting upon the twigs and leaves of bushes and small trees. Standing on its hind legs, and bracing itself with its fore legs against the trunk or lower branches of a tree, its long neck enables it to browse at a surprising height. We have never exhibited this species and it has reached America on only one occasion.

Another species, closely related to the gazelles, is the South African springbok. As its name suggests, this animal possesses remarkable leaping ability. Like many other antelopes it is extremely nervous in temperament. Any sudden fright may cause it to dash blindly into the fence, usually with disastrous results. We have had no great success in maintaining the springbok at the Zoological Park. All too often the combination of nerves, leaping ability and fences has spelled disaster.

Like our pronghorn, the springbok has a warning device, a "white flag" of erectile hairs on the rump. In this case the hairs form the lining of a pouch-like fold, about eight inches in length, along the mid line of the posterior part of the back. When danger threatens, and at will, this pouch is partially everted and the hairs erected, "flashing" into a conspicuous white crest. This unusual arrangement is possessed by no other animal and the specific name of the springbok, *marsupialis,* from the Latin *marsupium* or pouch, refers to this peculiarity.

A collection of antelopes is not complete without a specimen of that fine animal, the



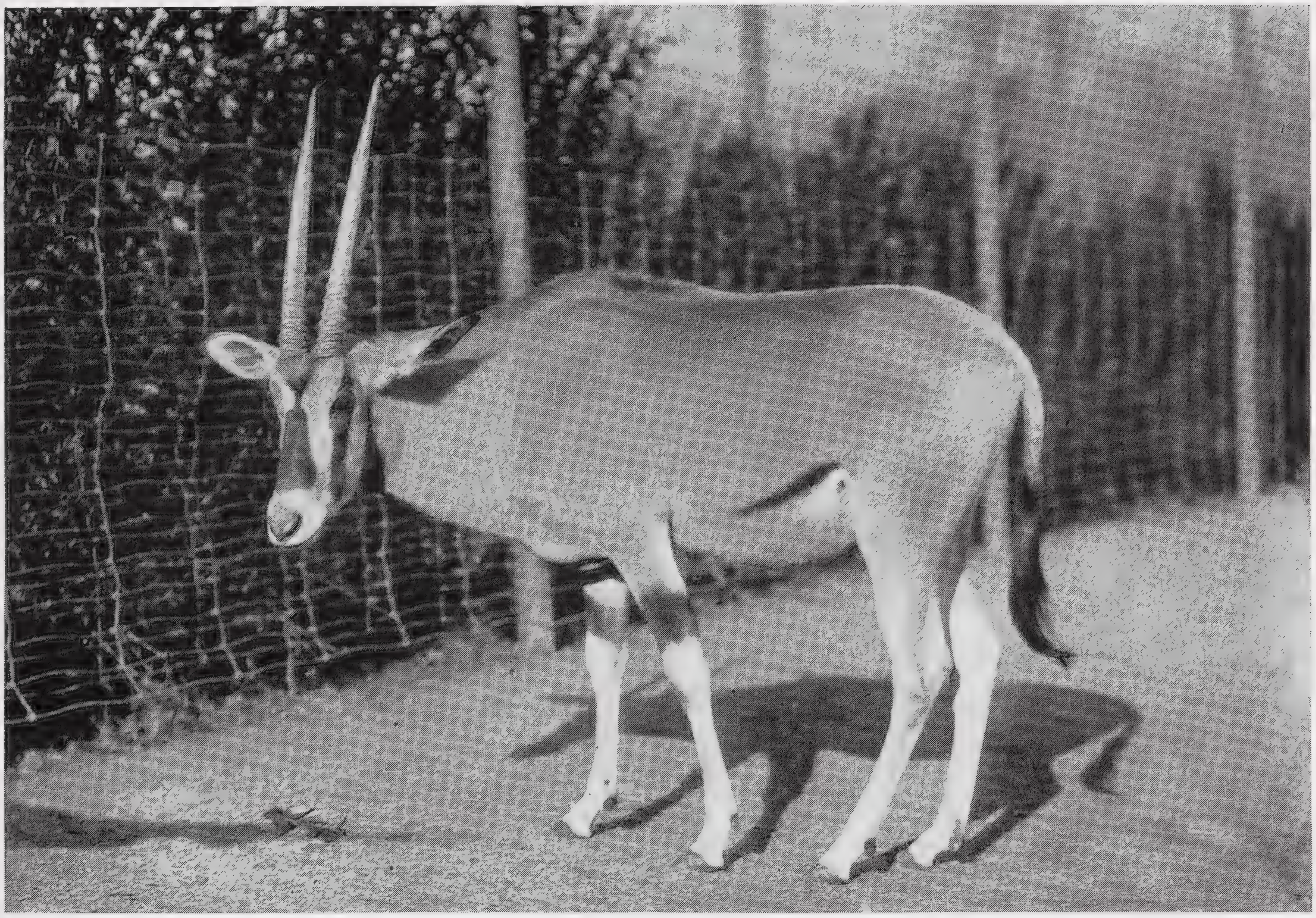
Baker's roan antelope, or the tufted-eared race of the roan, is slightly larger than the sable. This particular specimen is not quite typical, in that its horns have been worn down considerably by several years of fruitless hooking at the keeper through the cage bars.

sable. Few visitors can resist the urge to stop and quietly admire its noble carriage and magnificent, scimitar-shaped horns. The handsome head is one of the most sought after trophies offered by the big game animals of the world. At present, we have only the sable to represent this group of African antelopes but we have also exhibited the closely related and somewhat larger roan and the tufted-eared race or Baker's roan.

Several representative members of the Oryx group are certain to be found in the Antelope House. The prominent face markings and the long, spear-like horns are characteristic. It is interesting to note that in the gemsbok the horns of the females are longer and heavier than those of the male, thus reversing the condition found in most bovines. In the white oryx the horns are curved, scimitar fashion. The different species are fairly well marked and usually readily identified but, with the exception of the beisa and the addax, there has been much confusion of names formerly ascribed to the various species. Then too, each species has several races that are much alike. We have exhibited the gemsbok, the beisa, the fringe-eared beisa, the leucoryx or beatrix antelope and the white oryx. We have also exhibited the addax. It differs from true members of the oryx group chiefly in possessing spirally curled horns like those of the lesser kudu.

Outside of the blackbuck the best-known Indian antelope is the nilghai. It does well in captivity and being one of the largest of antelopes and friendly to visitors is a conspicuous member of our collection. Several young animals have been born in the Zoological Park. The nilghai is somewhat ungainly in general appearance because of its long fore legs, and the horns, the crowning glory of so many antelopes, are short and straight. It is, nevertheless, a handsome animal and the largest Asiatic antelope.

Once previously, we have exhibited the little



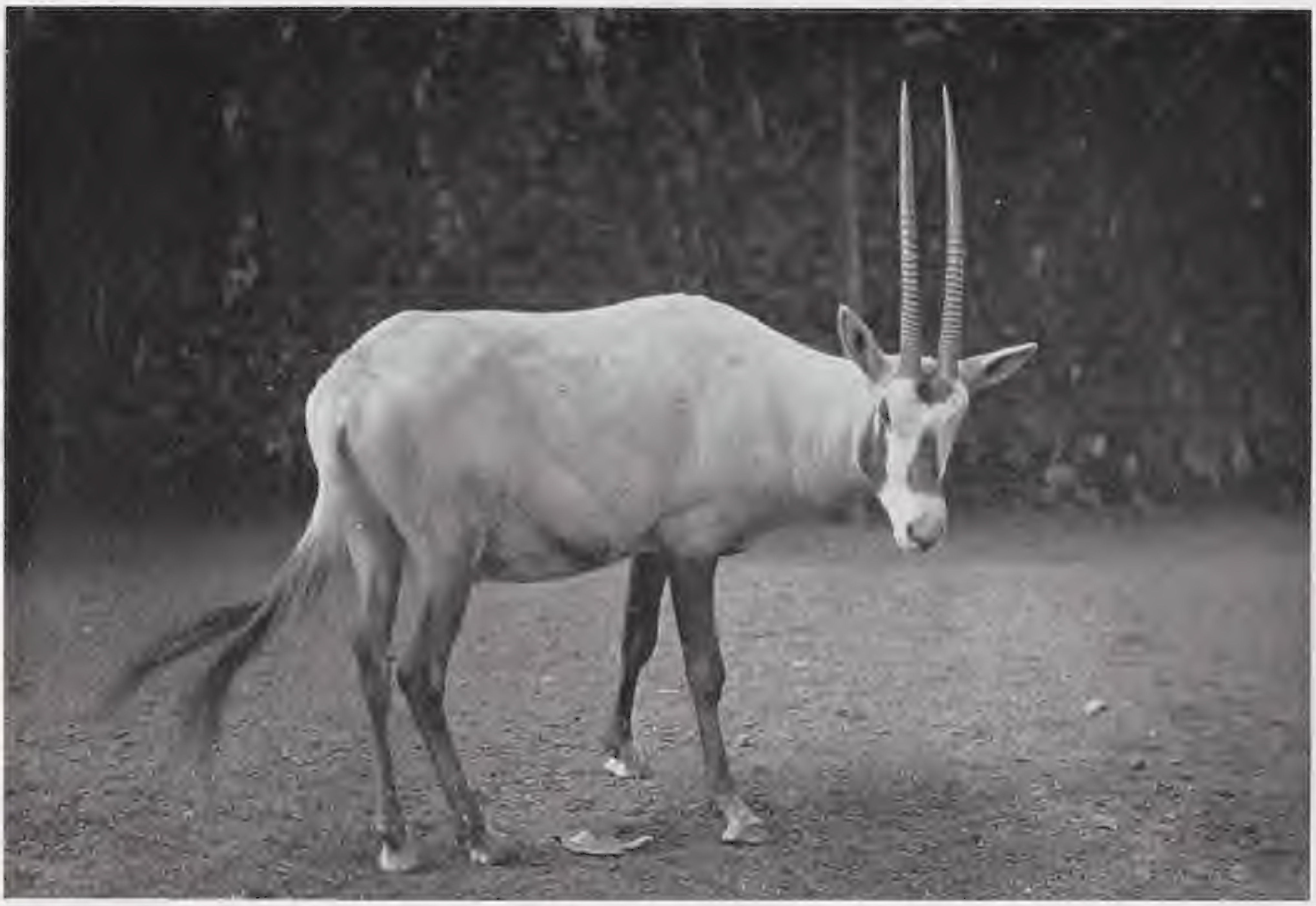
The beisa belongs to the group of straight-horned antelopes, with horns that sometimes measure 40 *inches—a weapon of great effectiveness in dealing with the smaller game-killing carnivores. This is the best-known and most commonly seen member of the oryx group.*

four-horned antelope which, in spite of the disparity in size, is closely related to the nilghai. It stands about twenty-five inches at the shoulder. In addition to a pair of normally-placed horns it possesses a second pair just above and between the eyes. Our single specimen survived in New York for about a year.

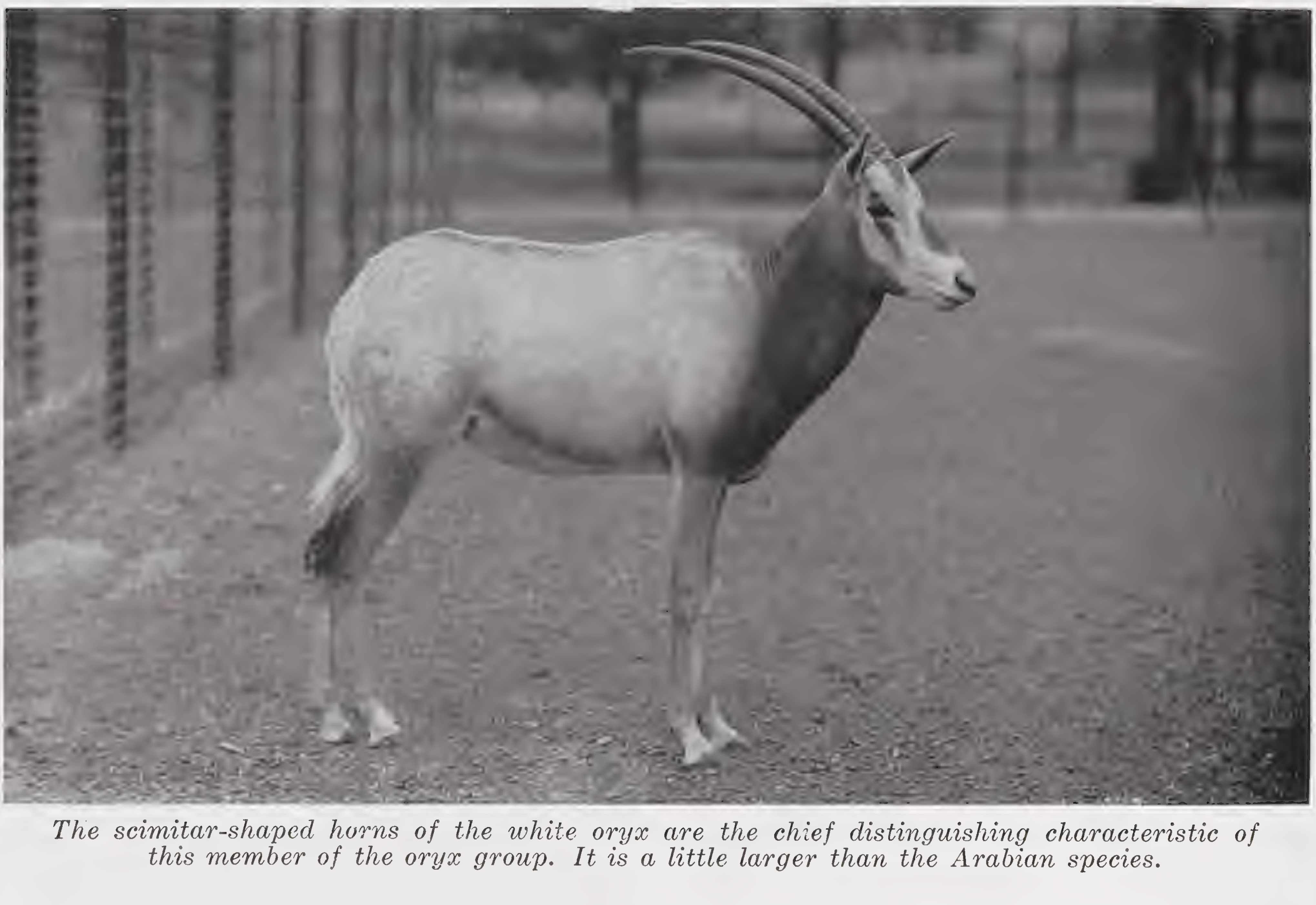
The so-called harnessed antelopes and their allies include the most beautiful of the world's antelopes and we are fortunate in having been able to exhibit practically all of the more strikingly-colored and better-known members of the group. The term "harnessed antelope" refers to the transverse white stripes which, in the more typical species, are arranged in harness-like fashion against the generally reddish-brown background of the body. Typical representatives of the group are the bushbucks, kudus and the nyala.

We have not exhibited a bushbuck since 1917 and apparently none has reached this country in the meantime. The several local races of the bushbuck differ considerably in color and the distinctness of their white markings. Females are fairly constant in possessing a chestnut body color with white stripes, while the darker males sometimes show but a trace of the stripes. The typical bushbuck from West Africa is certainly one of the world's most handsome animals. The body is bright rufous, passing into black along the back and the underparts. There is a dorsal crest of white hair and the white "harness" and body spots are set off strongly against the red background. In some of the races the males are nearly black.

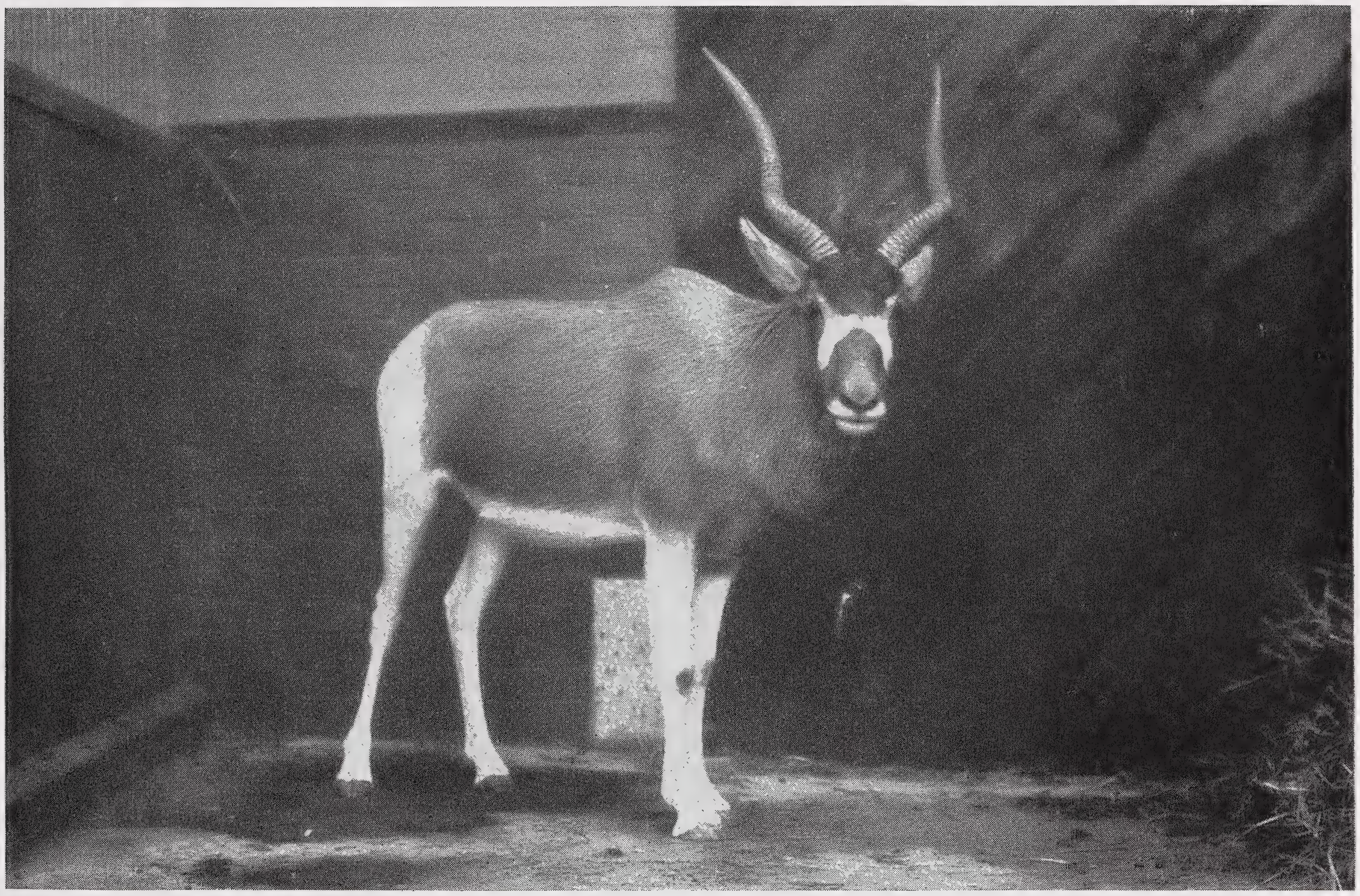
We have never exhibited the nyala (*Tragelaphus angasi*) and it has been shown in this country only once before. Unlike other members of the group, the males have a mane or fringe of long, silky hair down the throat, across the chest and upper legs, along the underparts of the body and across the thighs to the tail. There is also a dorsal mane on the neck. The body color is slate gray and the legs are brown. This



The Arabian oryx is a desert type, as indicated by its rather large, spreading hooves adapted for rapid travel across yielding, sandy country.



The scimitar-shaped horns of the white oryx are the chief distinguishing characteristic of this member of the oryx group. It is a little larger than the Arabian species.



While related to the oryx group, and a desert-dweller, the addax is slower and more ungainly, and its horns are not so handsomely formed.

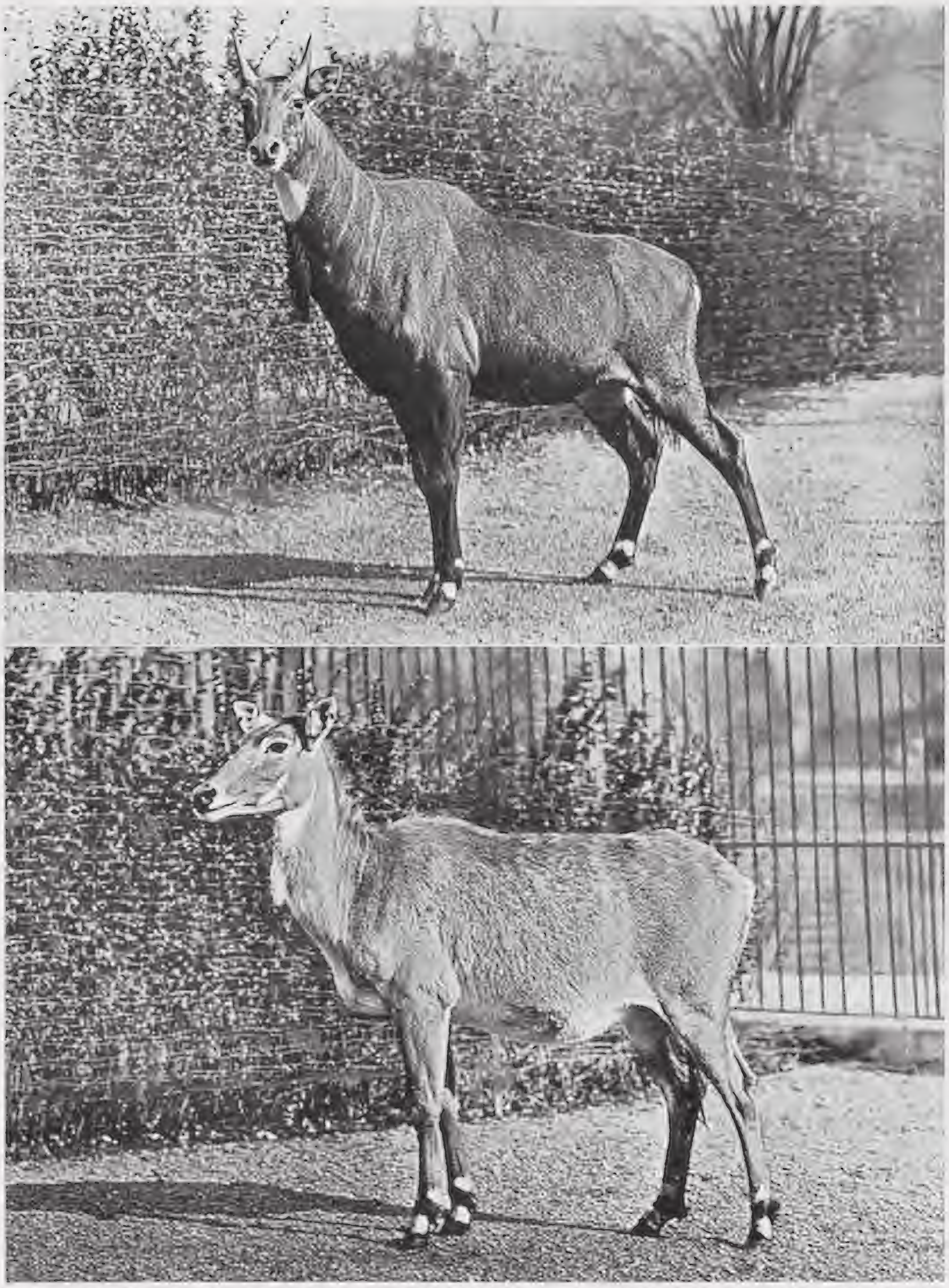
is another extremely handsome antelope, a prize for any collection.

We have had good success in maintaining the greater kudu and the female of our present pair was born in the Zoological Park. Many sportsmen claim that this antelope offers the finest trophy to be obtained in Africa. Certainly the combination of such magnificently turned horns and a beautiful and graceful body is difficult to surpass. Although we have been successful with the kudu, other institutions have found it rather difficult to maintain.

In spite of the fact that she was born in the Park our female greater kudu gives us a lot of trouble and is, perhaps, the most nervously unstable animal in the Antelope House, not nearly so reliable as her mate from the wild. Any occurrence out of the ordinary is liable to give her a case of "nerves." At such times it is pitiful to watch her frantic efforts to escape the wholly imaginary dangers.

She also has an unfortunate memory for the unusual. Last fall some large plants were being moved into the Antelope House for the winter. The ensuing commotion greatly excited the kudu. At the same time a Catholic Sister, arrayed in black robes, led into the House a rather noisy group of school children. By this time the kudu had lost every remnant of self control and was dashing madly about her inclosure. Keeper Kress, fearing that she might seriously injure herself, saved the day by opening the door to an outside corral, allowing her to rush from the building. Some weeks later, three other Sisters of the faith, this time unaccompanied by children, entered the Antelope House and paused in front of the kudus. Perhaps identifying them as the cause of her former fright, the kudu repeated the entire insane performance, and again was rescued from herself by Keeper Kress. His explanation for her actions that she was "frightened by the black robes" was not very well received by our astonished visitors.

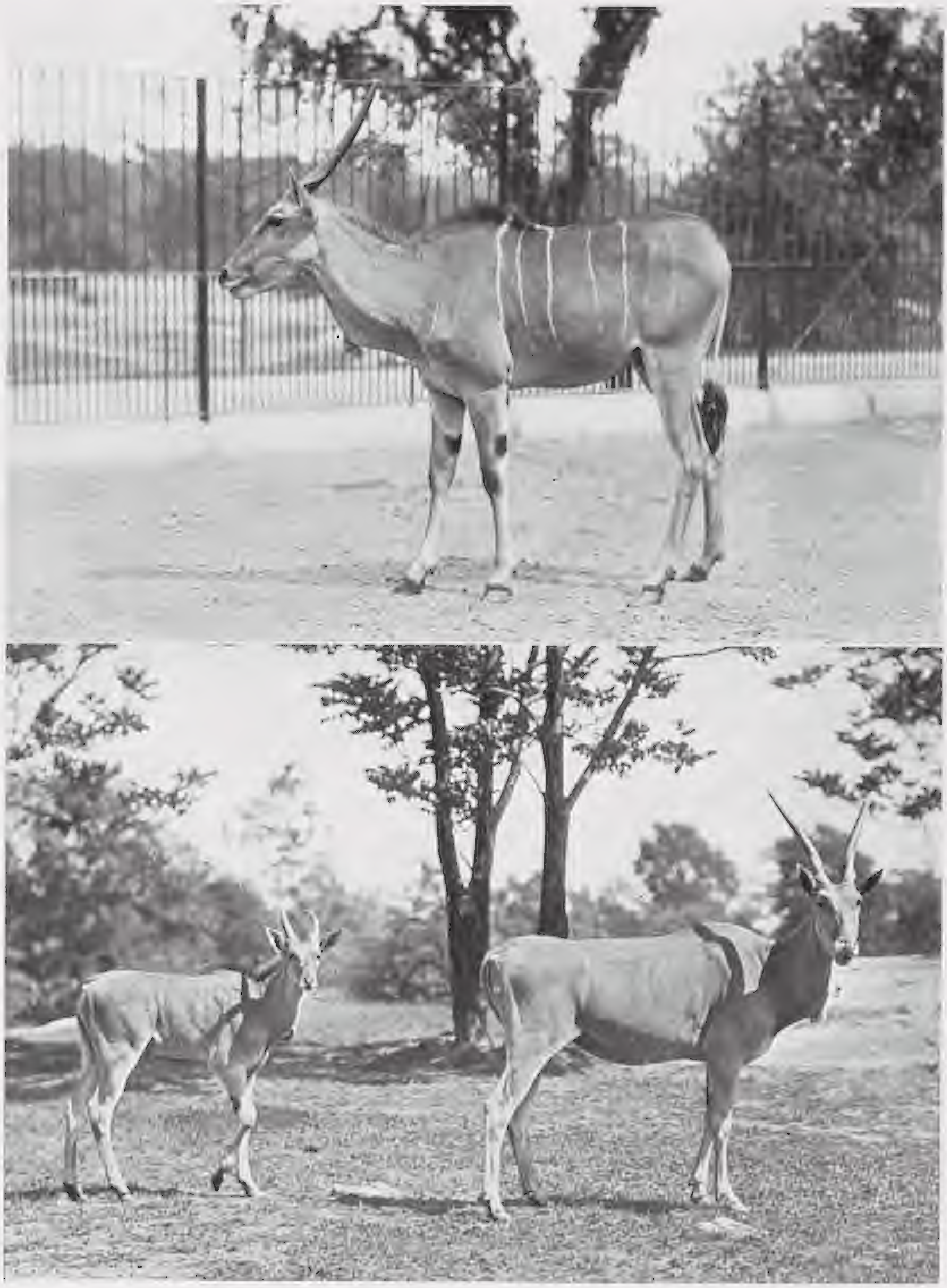
Speke's sitatunga and the Congo sitatunga have been represented in our collections and young of each were born in the Zoological Park. These specialized, semi-aquatic bush-



The nilghai is the largest of all the Asiatic antelopes, and would certainly be one of the outstanding hoofed animals of the world if its horns were in proportion. Above: adult male. Below: adult female.

bucks are known for their greatly elongated hoofs, an adaptation which enables them to get about on their native, reed-grown marshes, almost impenetrable to the hunter. Sitatungas do not look their best in captivity. They are not very graceful and our animals, while apparently healthy, were too slender to make a good appearance.

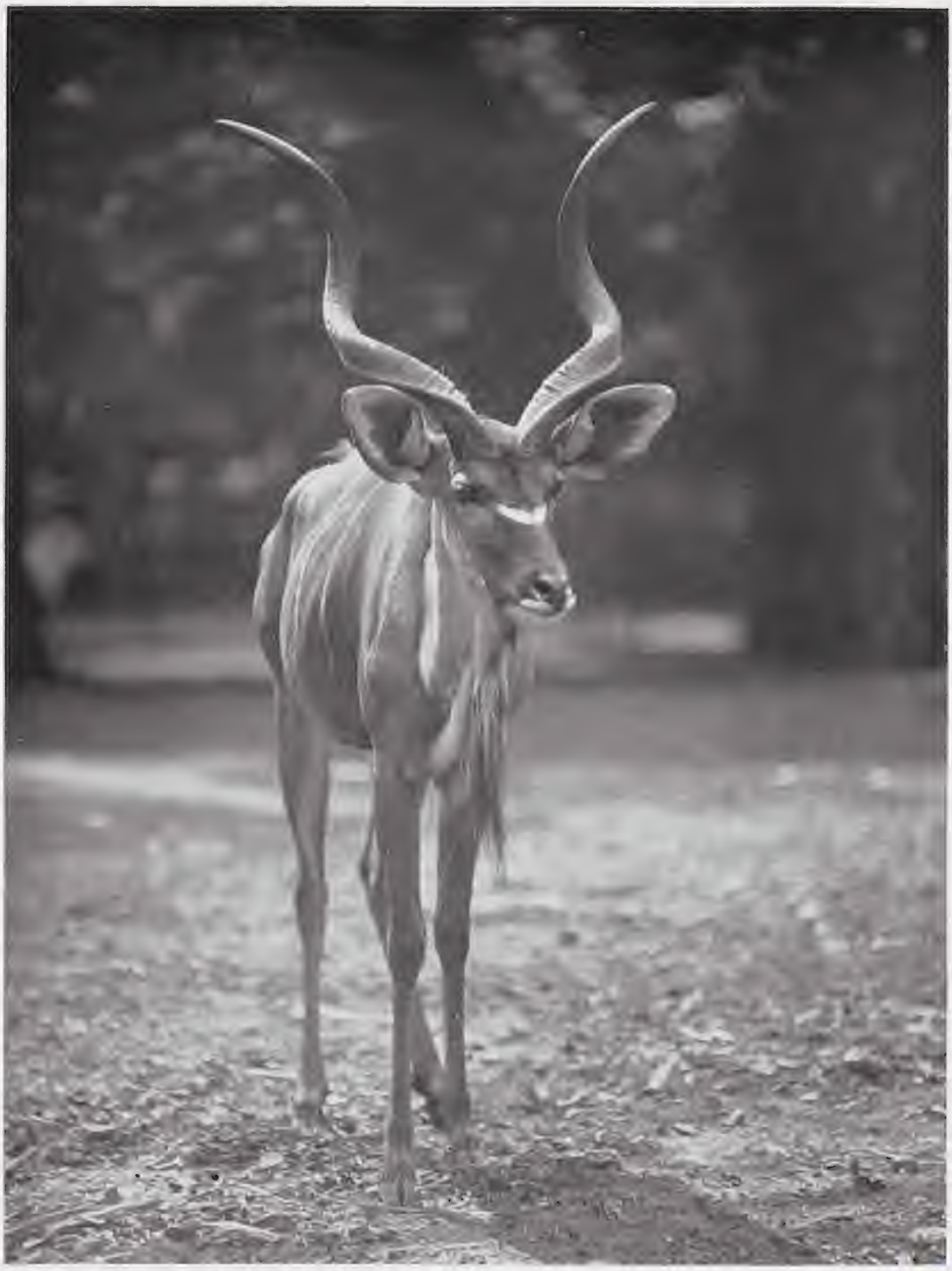
That exceedingly rare, forest-dwelling antelope, the bongo has been exhibited at the Zoological Park since 1933. Since her coming to the Park a great deal concerning the animal has appeared in these pages. She is now fully adult and outside of a few periods of truculence has always been a mild mannered "Queen of the Antelope House." Visitors generally concede her



The most cattle-like, and heaviest, of the antelopes are the elands. Old bulls may weigh 1,500 *pounds, and stand six feet high at the withers. Above: Livingston's eland. Below: the common eland.*

to be the most beautiful animal in the building. "Doreen" remains the only member of her species ever to be exhibited in this country.

Elands are the largest and most heavily built of all antelopes. Old bulls may stand six feet at the withers and weigh 1,500 pounds. They differ from all their near relatives, except the bongo, in that both sexes possess horns. The dewlap, so prominent in old bulls, is likewise unique and adds considerably to their generally bovine appearance. Elands north of the Zambesi river are generally marked with transverse, narrow white lines, like their allies, the harnessed antelopes. In the typical southern race these stripes are evident in the young but are gradually lost as the animal becomes adult. The



In many respects, the greater kudu is the finest of all the antelopes, for it combines good size with white stripes against grayish-brown, and a pair of magnificent, gracefully turned horns.

face markings also differ somewhat in the several races. Bulls have an interesting peculiarity in possessing a large tuft of hair on the forehead. We have not exhibited any of the northern elands for some years. Elands do well in captivity and several young have been born in the Zoological Park.

The preceding pages set forth a brief history of our antelope collection. As already mentioned, a more or less continual change takes place in any collection of live animals. Even while these pages were being written such inevitable changes have occurred. During the past week a blackbuck died of old age and a fine pair of springboks, a species not represented for eighteen years, has just been placed on exhibition. Other changes are likely to occur by the time these lines are seen in print.

The following forty antelopes, mentioned in the preceding pages, have been exhibited here:

Antelopes in the New York Zoological Park, 1903-1938

Lelwel hartebeest	*Alcelaphus lelwel lelwel*
Tiang	*Damaliscus korrigum tiang*
Bontebok	*Damaliscus pygargus*
Blesbok	*Damaliscus albifrons*
Brindled gnu	*Gorgon taurinus taurinus*
White-bearded gnu	*Gorgon taurinus albojubatus*
White-tailed gnu	*Connochaetes gnu*
Duiker	*Sylvicapra grimmi*
West African Duiker	*Cephalophus dorsalis*
Oribi	*Ourebia ourebi*
Sing sing waterbuck	*Kobus defassa defassa*
Lechwe	*Onotragus leche*
Mrs. Gray's or Nile lechwe	*Onotragus megaceros*
White-eared kob	*Adenota kob leucotis*
Chanler's mountain reedbuck	*Redunca fulvorufula chanleri*
Reedbuck	*Redunca arundinum*
Saiga antelope	*Saiga tatarica*
Blackbuck	*Antilope cervicapra*
Dorcas gazelle	*Gazella dorcas dorcas*
Isabella gazelle	*Gazella dorcas isabella*
Addra gazelle	*Gazella dama ruficollis*
Springbok	*Antidorcas marsupialis marsupialis*
Sable antelope	*Hippotragus niger niger*
Roan antelope	*Hippotragus equinus equinus*
Baker's roan	*Hippotragus equinus bakeri*
Gemsbok	*Oryx gazella gazella*
Beisa	*Oryx beisa beisa*
Fringe-eared beisa	*Oryx beisa callotis*
Arabian oryx (Beatrix)	*Oryx leucoryx*
White oryx	*Oryx algazel*
Addax	*Addax nasomaculatus*
Nylghai	*Boselaphus tragocamelus*
Four-horned antelope	*Tetracerus quadricornis*
Bushbuck	*Tragelaphus scriptus scriptus*
Speke's sitatunga	*Limnotragus spekei spekei*
Congo sitatunga	*Limnotragus spekei gratus*
Greater kudu	*Strepsiceros strepsiceros strepsicero*
Bongo	*Boöcercus euryceros isaaci*
Eland	*Taurotragus oryx oryx*
Livingstone's eland	*Taurotragus oryx livingstonei*

Our Fur-bearers—a Vanishing National Resource

Each Year Sees a Decrease in the Number of Pelts Taken, and the Situation Calls for Quick and Intelligent Action

W. J. Hamilton, Jr.
Zoology Department, Cornell University

THE trade in furs is one of mankind's oldest industries. In pre-Biblical times furs were trafficked in; history tells us of their use by early Greeks and Romans. It is a certainty that furs have been widely used for the past fifty centuries by mankind, and there is little reason to doubt that the cave man utilized the pelts of animals he had killed with primitive weapons. No century, however, has seen the almost universal adoption of furs, and the consequent destruction of fur-bearing animals, as has the past hundred years. During the last two decades the world has truly become fur conscious. Fur coats, scarfs, and trimmings, priced at every level, have made it possible for milady in every strata of society to own some garment adorned, in part at least, with fur.

This widespread use can mean but one thing—eventual extermination of some of our finest native mammals. Already some have been driven beyond the boundaries of our Union; others are reduced to such scarcity that early extirpation seems inevitable. We can never hope to restore our fur animals to the level of pioneer conditions. But most of these fine species may again be restored to numbers that will play a social and economic part in the rural communities of America.

One may weary of statistics, but they serve a purpose in establishing the immensity of the fur industry. Ashbrook[1] has supplied the following data: about $26,000,000 worth of furs imported and $100,000,000 exported annually; $121,000,000 worth used annually in the states (retail value of furs and trimmings used annually in the United States $500,000,000); 20,000 concerns in the United States handling furs; 2,000 wholesale manufacturers of furs in New York with 8,000 workers; 160 fur-dressing and fur-dyeing concerns, with 5,500 workers, annual payroll $8,400,000, dressing and dyeing 40,000,000 skins annually, exclusive of rabbits. The same author states that at the turn of the present century the value of the annual fur catch to the trapper was roughly estimated at $25,000,000. In 1925 the value had increased to $70,000,000, due almost entirely to a rise in pelt value. If the supply of fur animals had been maintained in suitable areas, the income to trappers would probably have exceeded this by a substantial amount.

Some may scoff at this figure, accustomed as we are in recent years to think in terms of billions. Nevertheless, this return to the trapper is a very tangible one, and has been the means of providing partial employment to many who might otherwise have experienced want. The trapping industry is not localized; individuals in every hamlet in the country help to harvest this rich annual crop. The farmer and his boy reap a tidy sum from pelts taken in slack winter months, young men have financed their college years through the sale of muskrat pelts caught in earlier days. Fur-bearers have provided a legion of rural lads with their first pocket money, and many a mortgage has been partially satisfied through the sale of furs. Country merchants supplement their income through the resale of furs bought in their communities, while traveling buyers often purchase more than $25,000 worth of furs in single counties of our northern states.

Trapping is usually conducted as a sideline

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[1] Fur Farming for Profit, p. 4.

Photo by Walter Arnold

The brown coat of the weasel is replaced by white in winter and it is during this phase that the "ermine" is trapped. Formerly worth a few cents only, the pelts rose in value to two dollars, but the trapper receives less than fifty cents in the current market.

to more permanent work, notably farming, ranching and the rural trades. But it is not unusual for residents of large metropolitan areas to make a tidy sum from muskrat trapping, even in such thickly populated areas as New York, Chicago, and Boston. While catches are not excessive in these urban areas, within recent years boys have collected several hundred dollars' worth of fur in a single winter on the site of the 1939 World's Fair. The Adirondack trapper has a good season when he nets $500. In the marten country of the high Rockies, it is not unusual for the trapper to earn more than $1,500 in a winter. The successful coyote trapper of the southwest usually traps less than a thousand dollars' worth of fur. A pair of good 'coon hounds will often return their master more than a hundred dollars in a week of fall hunting. It is the farmer and his boy, together with the young men of the countless villages which dot the country, who take the bulk of the fur. One has but to attend the great auction sales in the fur centers to appreciate the colossal numbers of animals taken by American trappers each season.

It is impossible to obtain satisfactory or complete statistics on the fur trade, but a brief idea of the tremendous annual drain on the fur animal population has been given by Osborn and Anthony.[2] The table below is actual recorded sales of the skins of a few American fur-bearers in 1919, 1920, and 1921:

Muskrat	14,109,288
American Opossum	9,987,742
Skunk	6,875,574
Weasel	3,492,412
Mink	1,683,900
Red Fox	1,295,258
Total	37,444,174

These more than 37,000,000 pelts represent only a small fraction of the actual numbers taken. Nor does the figure include such favorites as the raccoon, gray fox, civet cat, otter, marten, coyote, badger, bobcat and many others. A very large share never reach the auction blocks. Trappers have taken more than 6,000,000 muskrats from the bayous of Lousiana's coastal lowlands in a single year; the relatively small state of Maryland yields to her marsh owners a million 'rat crop annually. A single swamp in upstate New York produces 5,000 marketable muskrats each winter.

For other than their pelt value, many of our fur-bearers are justifiably considered ex-

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[2] *Journ. Mammalogy,* III, 219-237.

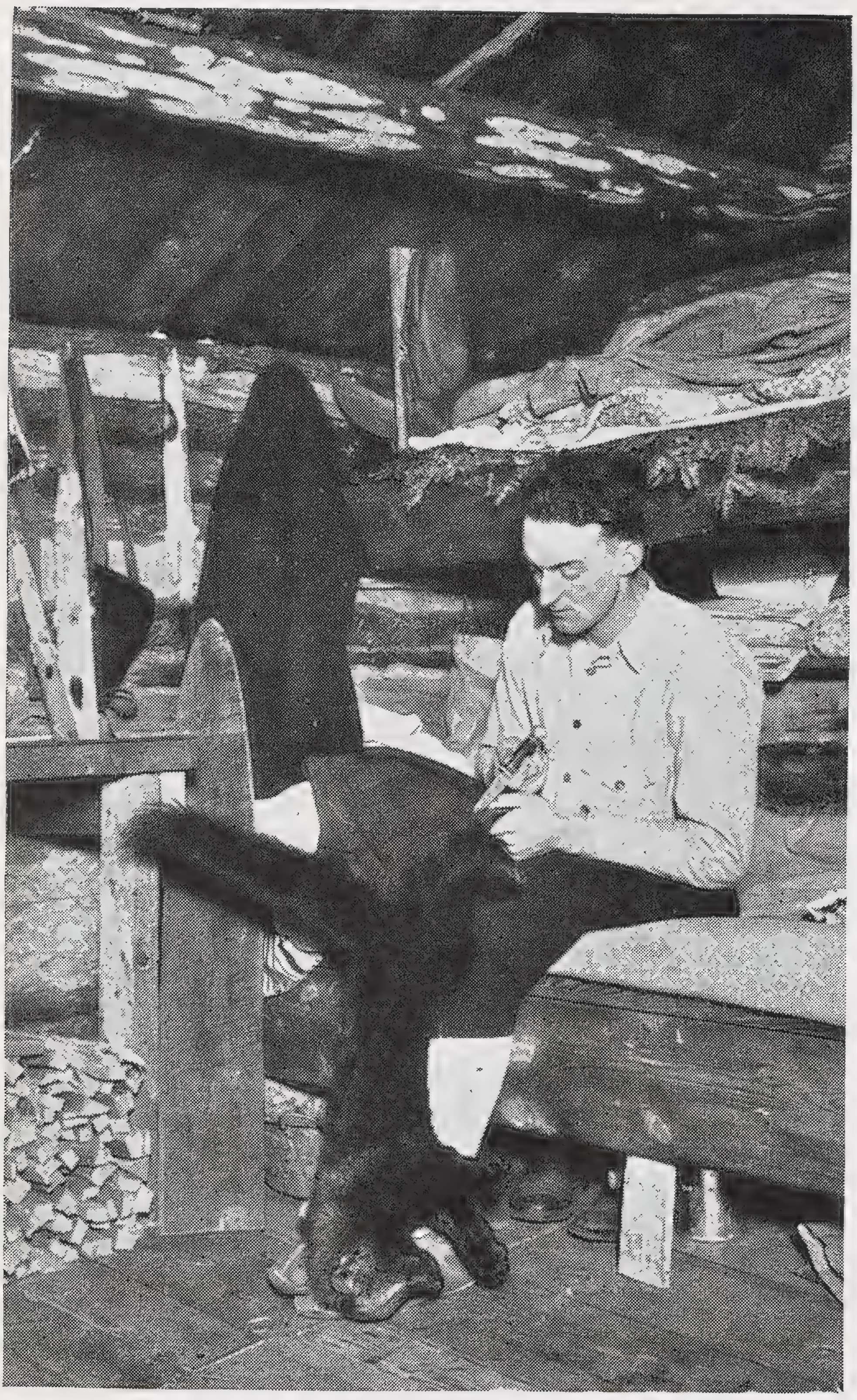

Photo by Walter Arnold

Prize of the trapline—a prime large fisher. Both the fisher and the marten are now in imminent danger of extermination.

cellent game. The raccoon is a splendid sporting proposition. From Maine to Florida westward to the Pacific, 'coon-hunters trap the beech ridges or wade the cypress swamps in the fall eagerly listening to the frenzied baying of well-trained hounds. More often successful than not, these nocturnal hunts spell the doom of more than a million raccoons each year, and return a rich dividend to the hunter, whether he pursues the sport for pleasure or profit.

The red fox is a game species par excellence. A number of states, realizing its value to the hunter, have outlawed the fox trapper. There are those in the South who feel it is a sacrilege to kill this splendid beast, full realizing its worth to the great hunt clubs. Coyotes are religiously hunted by westerners who employ trained wolfhounds and other fast breeds of dogs. Although realizing that the mountain lion is a possible menace to deer, others would hesitate to see it go, for it does provide an exciting hunt. Bobcats are hunted in many states. They lead the hounds a merry chase and are only treed after a long run.

We may credit our fur-bearers with yet another value. The flavor of muskrat flesh is not unlike that of wild black duck. The markets of Philadelphia, Wilmington and Baltimore absorb large quantities each year. While muskrat flesh usually parades under the nom-de-plume of "marsh rabbit," it also is camouflaged as "Chesapeake Bay terrapin." In recent years trappers have received from 15c to 25c for dressed carcasses. Opossum is a *pièce de résistance* to the southern darky. With prevailing low prices for the pelts, the unskinned animals

Photo by J. C. Grigg

The muskrat is the banner of the fur trade. This morning's catch from an Iowa ditch netted the trapper fifteen dollars.

are fetching 35c each in the current New Jersey market. Roast 'coon is considered a rare delicacy; a number of other fur-bearers, not excepting the bobcat and the mephitic skunk, have been pronounced of fine flavor and toothsome.

One would surely think that this great natural heritage would be zealously guarded from depletion, and strong conservation measures taken to perpetuate these valuable native mammals. It is a lamentable fact that such is far from true; a drastic decline in fur animal population is increasingly evident. Our fur resources have been called the "stepchild of conservation." Ashbrook[3] has stated that the raw fur catch of 1925-26 was approximately 20% lower than in the previous year, and the decrease for 1926-27 was even more marked. The deficit continues to grow. For the past ten years I have received alarming and distressing reports from scores of trappers and fur-buyers from widely separated districts of the Union. The story does not vary. Each year sees a decrease. A recent report[4] on a fur survey of the two-million-acre Clark National Forest in the Ozarks should prove of interest to conservationists. All fur-bearers, with the exception of the wolf and gray fox, have shown a sharp decrease in numbers from 1932 to 1937. The decrease in muskrat, mink and raccoon during this period has been so rapid that all indications point to their being extirpated within a very few years if present decimating factors (chiefly trapping) continue. Skunks and opossums have shown such a drastic reduction that their numbers, from a commercial standpoint, are threatened. The Louisiana muskrat catch has declined from six million in 1924 to a two million catch during the past six years.

Mink have decreased 80% in the prairie states in the past decade, while they no longer are abundant in the great marshes of central

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[3] Farmers Bulletin No. 1552.

[4] *Journal Wildlife Management*, Vol. 2, p. 22.

Photo by S. C. Arthur

Endless marshes like this are the reason why more fur animals are trapped in Louisiana than in any other state. In the 1924-1925 season, Louisiana produced more fur-bearers than Canada and Alaska combined, although the Canadian catch was by much the more valuable.

New York, nor the wooded streams of rugged New England. During the 1929-30 trapping season in Kansas, there was a 60% increase in licensed trappers from the previous year, yet fewer animals were trapped.

Let us, for a moment, view protective measures over the past thirty years and establish what they have done for the fur-bearer. A quarter century ago, exactly half the states of the Union gave no protection to our fur animals, a few of these alone excepting the beaver and two or three adding to this the fox and otter. Skip ten years, and we find lawmakers at last realizing the value of the fur crop, and restraining the trapper during the fur boom of the early 'twenties. In 1921 half of the states enacted legislation relative to fur animals, the general trend of which was to safeguard and conserve these animals and to insure further the prime conditions of peltries. Less than a dozen states now remain to fall in line with proper protective measures, and of these, most give protection to the beaver. Fur is becoming scarcer each year, prices remain high, and at last these recalcitrant Legislatures heed the warning of Federal experts and local fur buyers. By 1936 all but Colorado and New Mexico had provided protection for their principal fur-bearers; these two protect only the beaver.

Open seasons for taking fur animals have been shortened in an attempt to make trapping coincide with periods of primeness and not overlap into the breeding season of the various species. The old trapper was wont to say that pelts were worth taking in any month with an "r," meaning September to April inclusive. Such a statement, of course, has no basis in fact. As a boy trapper on the marshes of Long Island, I legally trapped muskrats from November 10 to April 20. The pelts were not prime before Christmas, and the muskrats were carrying young by late March. Today the New York trapper must restrict rat trapping activities between January 20 and March 20. I dare say he will receive as much for his fifty prime pelts as the earlier trappers were paid for their hundred blue pelted unprime hides.

That empire builder, the beaver, with his fascinating dams and lodges, provides a keen source of pleasure to lovers of the outdoors. Realizing this esthetic value, more than half of our states have given the beaver complete protection for many years. Hunted and trapped over a six months period in bygone days, the raccoon is now accorded a better measure of deserved protection. The otter, whose hide supports the most durable of pelts, has been unjustly condemned by fishermen, and for long was given no protection by all too many states. In the past few years eight states have added this fine animal to the protected list. The rare fisher, a prize the northern trapper forever seeks, was given complete protection by Michigan, Minnesota and Vermont as late as 1933. Realizing its great value, and the imminent danger of extinction with which it was threatened, four additional states now prohibit its capture. These instances will suffice to show that interest, long latent, has been aroused, and our fur-bearers are at last receiving a small measure of desirable protection.

It is interesting to review some results of protective measures. In general, fur animals quickly respond to such protection. Notable among these is the beaver.

Pennsylvania has much ideal beaver country but it is said there was not a single beaver remaining in the state when the Game Commission was established in 1895. Unrestricted trapping had long since wiped them out. Wishing to reestablish this big fur-bearer, the Game Commission released in the state, from 1919 to 1924, ninety-four individuals. From this modest beginning, favored by protection, the animals increased in a decade to an estimated 15,000. The figure seems incredible, but was based on a careful census and is reported to be conservative. With this increase, damage claims poured into the Commission's office. Finding the cost of satisfying these claims reaching prohibitive proportions, the Commission opened the season on beaver from March 1 to April 10, 1934. There was much opposition, but the officials, confident of their action, proceeded with their plans. Trappers took 6,408 beavers that first short season. The return to the trapper was estimated at $64,000, and the state is no longer concerned with complaints occasioned by the industry of this big rodent. The beaver is still abundant in Pennsylvania.

New York has a parallel to this. Beavers were wellnigh extinct in the late 'eighties. A few planted about 1905 have increased enormously. Open seasons in recent years have netted the trapper several thousand skins during the brief two weeks period.

Otters were formerly so rare in Massachusetts as to be considered nearly extinct. The capture of one afforded much publicity. Between 1913 and 1919 severely restrictive laws regulating trapping were passed, and it became difficult to catch an otter with a trap which could legally be used. As a result, these animals were unwittingly accorded almost complete protection. Within the past few years, otters have been frequently reported in all parts of the state, even in the environs of Boston.

Laws are not the only safeguard of our fur animals, nor are they a panacea for all the evils which beset the fur trade. Statutes are useless unless they are enforced. The pitiful number of officers responsible for safeguarding our valued wildlife can never successfully cope with the legion who break these laws.

We have seen that with few exceptions our fur animals are a disappearing race, in spite of drastic efforts of state Legislatures to minimize the decline by ever-shorter fur seasons. Legislation, however effective it may be in reducing the toll by the trapper, will not establish additional environment. Fur animals cannot increase, or even maintain their present population level, if adequate wild lands are non-available. Drainage projects, many of them ill-advised, have destroyed many millions of acres suitable for wildfowl and fur-bearers. In 1930, in agricultural drainage enterprises in the United States alone, there were included 84,408,093 acres—more than the combined total area of England, Scotland, Wales, Ireland and the Channel Islands[5]. Many of our great shallow lakes and wide bordering marsh lands, former nurseries for great numbers of muskrats, mink, otter and wildfowl, are now desert wastes of dry peat and alkali. Originally drained to increase agricultural lands, they have, in many instances, proved entirely unsuited to such pursuits, and stand as monuments to man's folly.

Other measures have contributed to the tragic decline. Predatory animal control in the West, through the use of poisoned baits, has contrib-

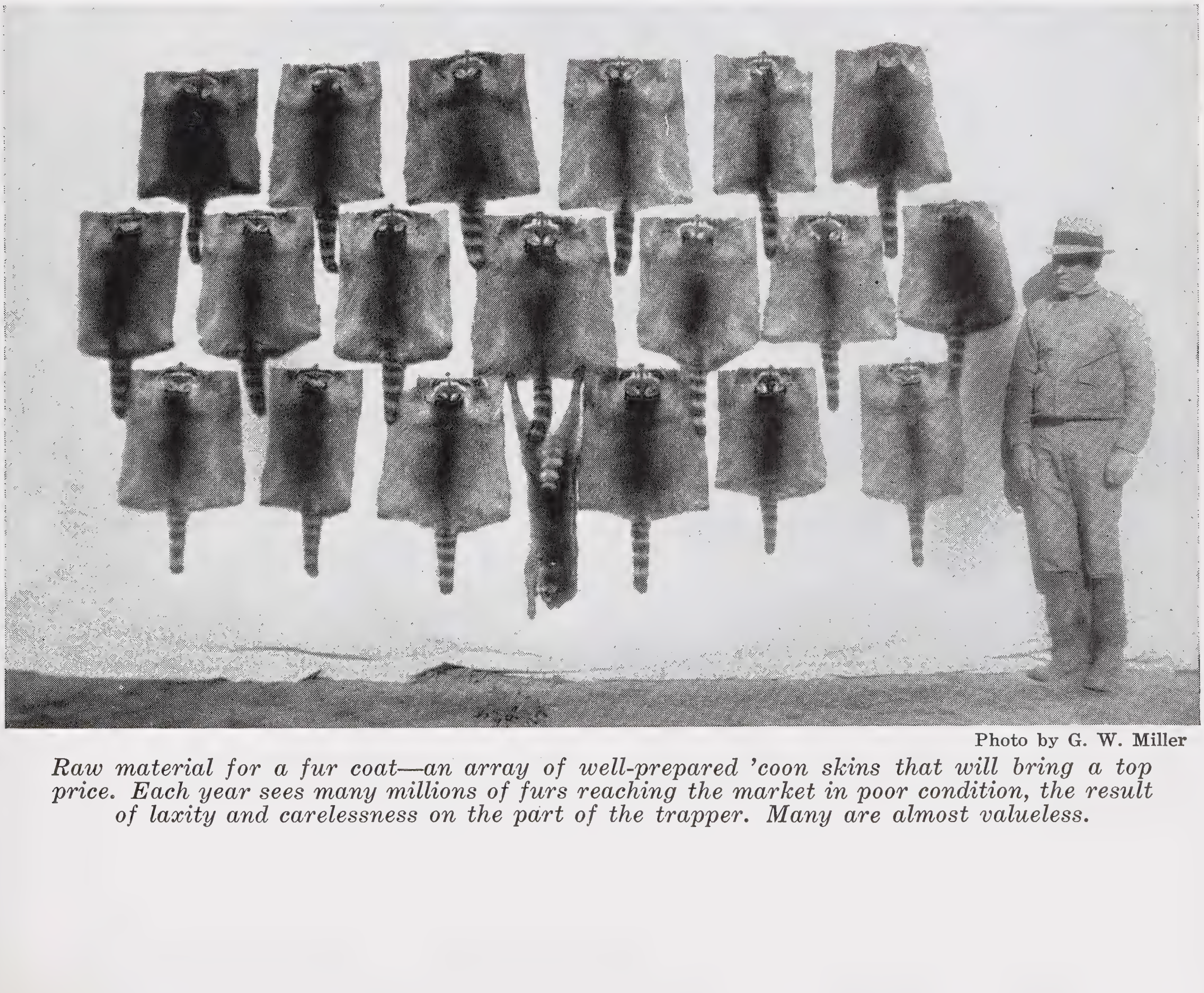

Photo by G. W. Miller

Raw material for a fur coat—an array of well-prepared 'coon skins that will bring a top price. Each year sees many millions of furs reaching the market in poor condition, the result of laxity and carelessness on the part of the trapper. Many are almost valueless.

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[5] National Association of Audubon Societies, Circular 32.

Photo by David Brazil

A fine morning's catch in the mountain country of the West. These nine furs will bring about $35 at present price levels.

ted to the death of thousands of useful fur-bearers which are of no concern to the stockmen. As a tool of the individual, this destruction continues, and has resulted in the ruination of many fine fur pockets.[6]

Many would have us believe that fur farming will prove the salvation of this vanishing race. It is true that ranching of fur animals, notably silver fox and mink, has increased tremendously in the past decade. Many millions of dollars are invested in this relatively new industry. It is also true that ranch-raised animals provide a very small share of the pelts which reach the fur market each year and has in no degree abated the pursuit of wild fur animals. Practically all the silver fox skins and an increasing number of mink pelts are provided by fur farms, but the raising of other fur-bearers in captivity has met with little success. Perhaps if fur farmers generally could adopt the plan of one nameless breeder, our wild fur resources could be conserved. When asked by an inquisitive visitor how often he removed the fur from each animal, the rancher replied, "Well, madam, after we pelt each animal two or three times, they become very nervous, and we must give them a long rest."

Fur merchants and the large raw fur receiving houses may be held partly responsible for this alarming crisis. By issuing price lists long before pelts are prime, it becomes a virtual invitation for the trapper to ply his trade prematurely. Overtrapping is thus encouraged by the very institution which should be most concerned with fur conservation. By accepting at a price any skin offered, the fur buyer encourages the trapper to clean up.

Our fur-bearers are at the crossroads. Many of our most valued species are gone from areas that were well populated a few years back. The population of others has been so substantially reduced that they do not figure in the fur crop. If we are to conserve a part of this important resource, *we must do so without delay.*

It would be highly desirable to establish uniformity in fur laws among those states having similar climatic conditions. This need has been repeatedly stressed by Federal biologists charged with fur conservation, but their pleas have elicited little response among agencies concerned with protective measures for wildlife.

Shortening of the trapping season to coincide, in a measure, with periods of prime fur, would prove a distinct and wise conservation measure. It would result in the taking of furs when at their greatest value and materially reduce the unprime pelts and trash which glut the market each year. Furthermore, it would minimize the destruction of mated animals during late winter, and provide a sufficient breeding population to restock the trapped area. We would scarcely think of cutting our wheat while the heads are yet green, or digging our potatoes while the plants are still in blossom. Is there any valid reason why we should continue to harvest a good share of the fur crop while pelts are unprime?

Furthermore, if we are to manage our fur resources intelligently, it is essential that some data be available on the number of animals taken from year to year. Are we taking thirteen million muskrats in this country every year, and only a like amount being produced? We must eventually license every fur-buyer, and insist that they return a report to their respective Conservation Departments on the number and kinds of pelts bought *from the trapper.* This will prevent duplication of records, and provide a return of some significance by which we might evaluate trends in the population.

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[6] Personal letters (1937) from western trappers.

Research of fur animals is sorely needed. It should be the duty and privilege of the fur industry to provide fellowships in the state colleges or universities for fur animal investigations. Only through such studies can we piece together the life history of our fur-bearers—a virtual necessity before sound fur laws can be established.

The death knell of several species was sounded long ago. Others are being crowded into oblivion. There is no necessity for terminating this vast annual harvest; involving a partial livelihood to many thousands of individuals. The fur trade is a billion-dollar industry. But we must face the fact that the remnants of our rich fur resources are fast diminishing. National conservation organizations and champions of wildlife everywhere must sound the alarm. Only through concerted effort can this fine native fauna be saved.

Photo by Walter Arnold

The end of the trail for this beauty, a fine red fox. The cunning of the fox is proverbial, but a good trapper with proper scent can take a hundred in a few weeks of fall trapping. Good pelts used to be worth $20 or more, but prices have fallen and few foxes are caught.

The Laboratory of the Department of Tropical Research

In a Secluded Part of the Zoological Park, Expeditions to the Far Corners of the Earth Have Their Beginning and Ending

JOHN TEE-VAN
General Associate, Department of Tropical Research

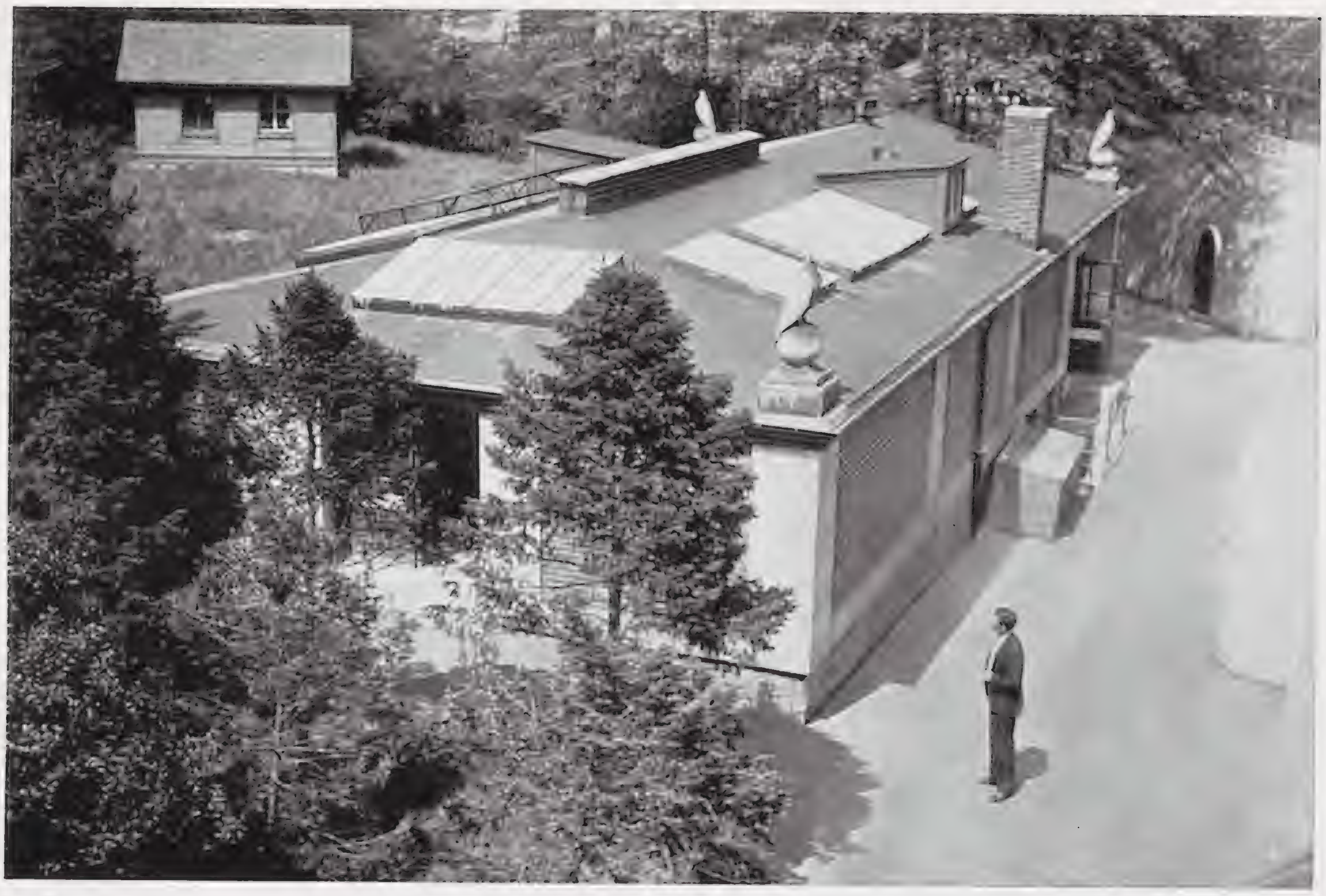
IN one of the Zoological Park's "No Man's Lands," partly hidden by the protecting flights of the Eagle Aviary, is a one-storied, rectangular, red-brick building, each of its four corners possessing a watchful stone eagle. For years these birds symbolized the winter home of their living tropical representatives. But in 1931, the entire building, emptied of its winged contents and altered in character though not in shape, became the permanent home of the work and collections of the Department of Tropical Research. The screams of eagles and the hissing of vultures, reminiscent of the building in its earlier days, have been replaced by the clatter of typewriters and the peculiar noises incidental to the study of fishes and other animals.

Twenty-six expeditions of the Department of Tropical Research have passed through this building. The planning and estimating of costs of field work, the purchasing and packing up of instruments and materials have been accomplished within these walls. From here, departure has been made toward jungle or ocean or distant island, and to this laboratory the expeditions return laden with specimens, photographs and notes.

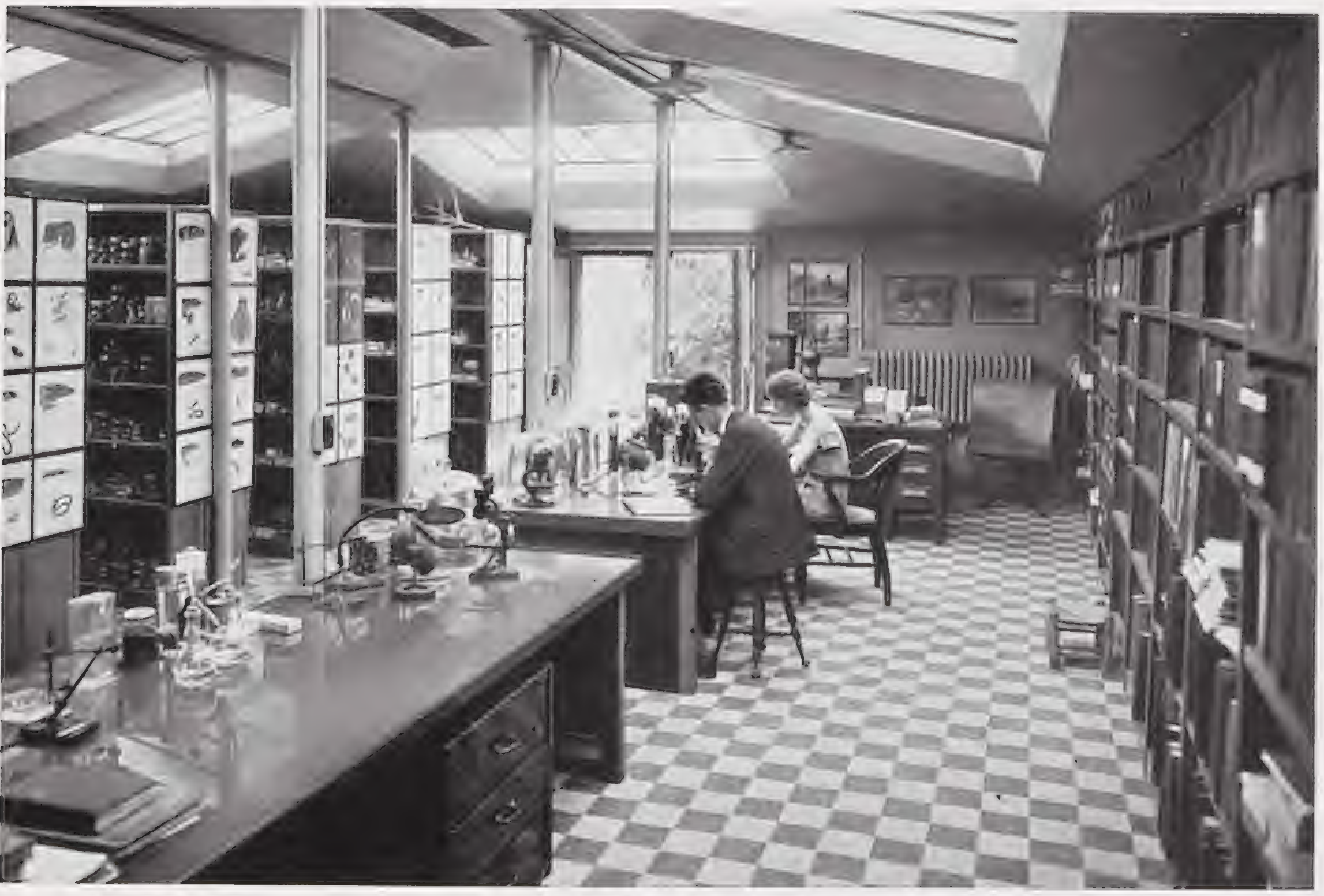
As in laboratories everywhere in the world, the present one is filled with all sorts of odd things, namable and unnamable—thousands of specimens from jungle or deep-sea or far away strand, instruments for examining them and for use in tropical forest or open ocean, shelves of books containing reports of many expeditions. Here are the beginnings and endings of attempts to do things differently, and the remains of onetime brightest of ideas, which, confronted with actual working conditions, turned out to be gloomiest of failures. One of the latter sits on top of a case of specimens—a large glass bell-jar fitted into a metal shoulder-yoke, the whole designed as an all-glass diving helmet. It was a marvellous piece of apparatus, enabling one to look upward and in all horizontal directions with the utmost clarity. All this was true until a descent was made into the water. Then, much to the chagrin of the designers, fishes and reefs were distorted and distances could not be judged, principally because it was forgotten that when water closed about the outside of the helmet the inner curved surface of the glass formed a powerful concave lens. This, when looked through, gave a twisted and perverted view. Thus, like the death's head at the feast, there sits in the laboratory staring at us, this everpresent reminder that more thought should always be given to the problem at hand lest some unforeseen aspect causes all our plans to go astray.

The laboratory building consists of four rooms; a library and office, two small rooms utilized principally for storage of collections, and the large laboratory room provided with instruments, work-tables and numerous stacks of shelves for books and for collections of fish and other animals.

The library and office has three sides devoted to bookcases and glass-fronted cabinets. Large shallow drawers house collections of eggs obtained during early studies of Director William Beebe in India and elsewhere and eggs laid by captive birds at the Zoological Park. Similar drawers contain the originals of hundreds of drawings used in the publications issued by the Department, black-and-white and color representations of animals ranging through the ani-



The laboratory of the Department of Tropical Research is quiet and secluded, hidden behind the concrete shelters of the Eagles' and Vultures' Aviary. Stone eagles watch from the corners, for the building once housed the raptorial birds.



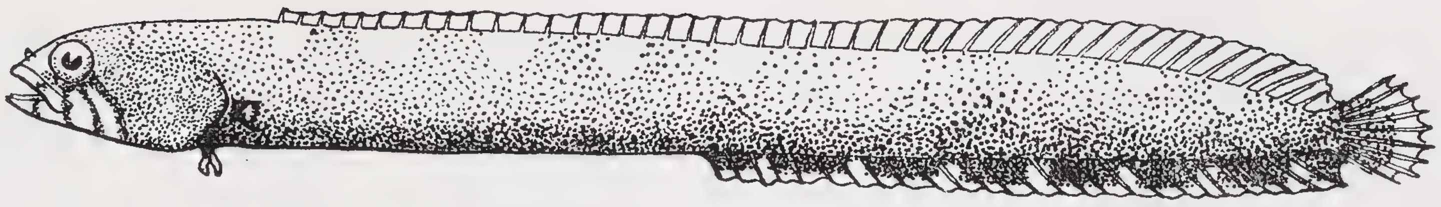
The large laboratory room has plenty of table space for the microscopic work that every expedition carries in its train. Part of the reference library is to be found here as well as long rows of shelves for collections of preserved specimens.

This is the permanent staff of the department. Left to right, seated: John Tee-Van, Dr. William Beebe; standing: Jocelyn Crane, George Swanson, Gloria Hollister. Occasionally special assistants are attached to the department when it is actually engaged in field work.

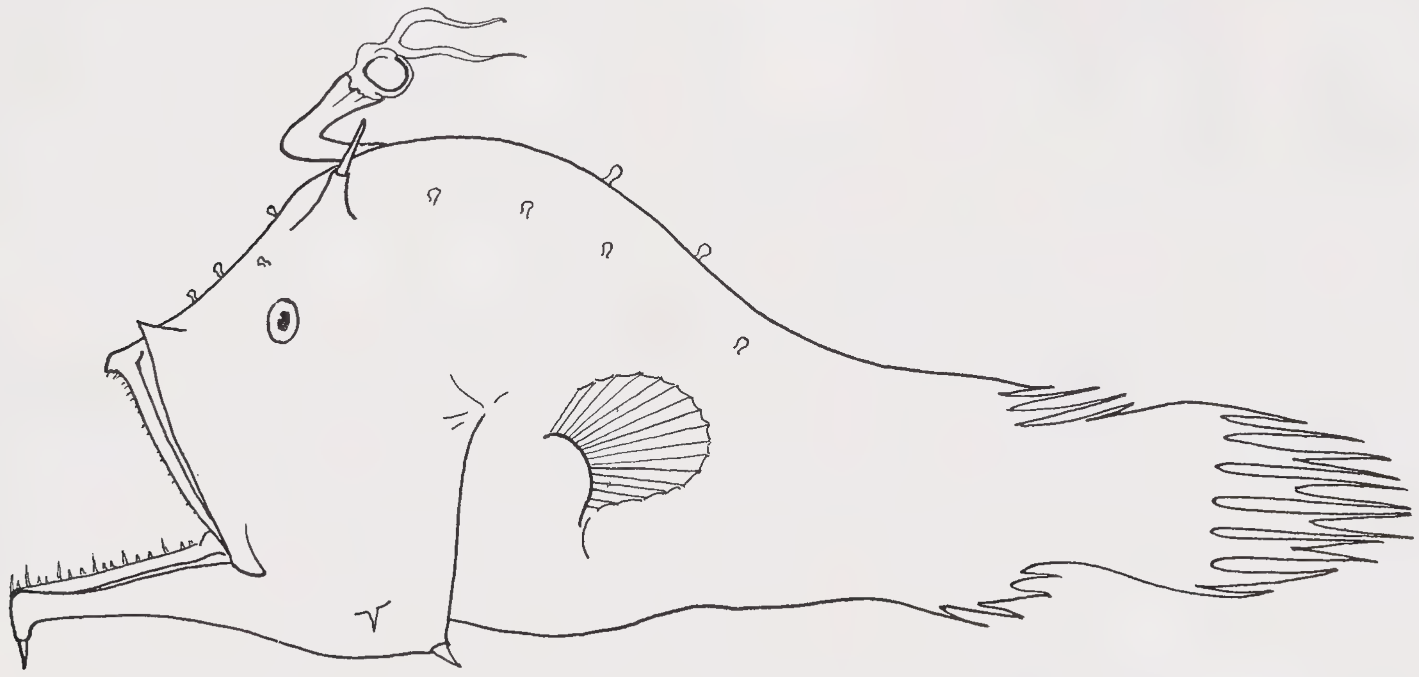
mal phyla. Almost as many more illustrations, some sketched, others finished, await the completion of half-accomplished problems and in their turn will be published. Well over a hundred albums of photographic prints taken during many years and in various parts of the world, correlate and control the vast number of photographic negatives that are stored in nearby boxes. Still other parts of the room furnish storage space for the notes and materials gathered in Asia by the Director while on the Pheasant Expedition. This expedition, which culminated in the four large volumes of "A Monograph of the Pheasants," lasted eighteen months and was accomplished before the formal founding of the Department of Tropical Research.

Within one part of the cabinet divisions is the most carefully guarded section of the collections—the types of new species. These preserved animals, oftentimes unique, are the focal points on which new species are based and must be carefully preserved for the use of future generations. Looking through the bottles and jars and insect-boxes that hold these specimens we stumble upon a vial holding a small, insignificant-looking fish whose beauties can be appreciated only when viewed through a lens. The label in the bottle tells us that it is the type specimen of the fish *Stathmonotus corallicola,* or, to put this name into its English equivalent, "the carpenter's rule that lives in the coral." Other containers bring forth equally strange and lovely words as the appellations of even stranger animals, and our eyes and ears can rejoice as we look at and pronounce such names as *Lophodolus lyra, Ultimostomias mirabilis, Haplophryne hudsonius, Saccopharynx harrisoni* and *Iridio bathyphilus,* the latter a fish whose name means, to translate very roughly, "the rainbow that loves the deeps."

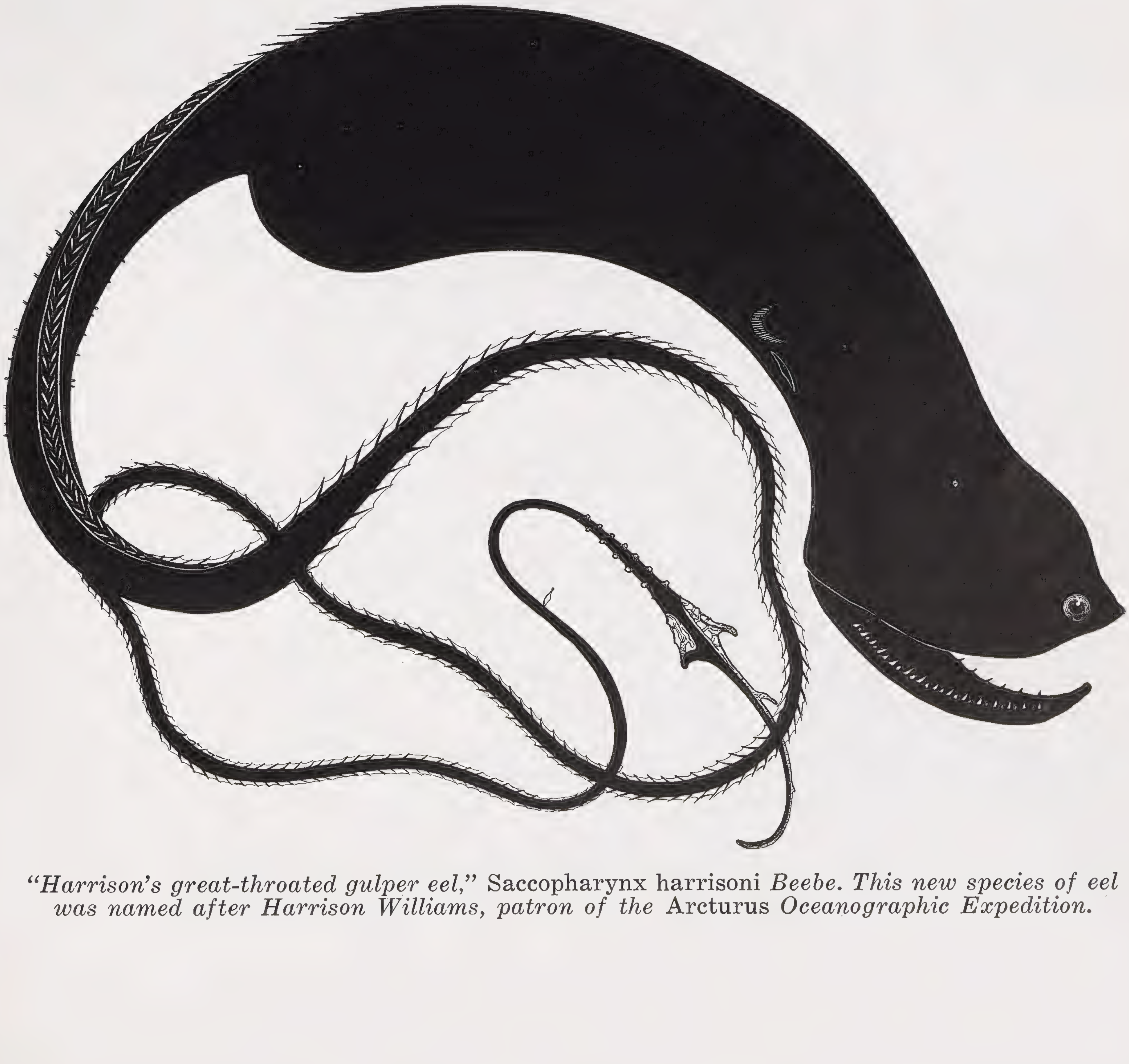
Farther on in the same room are cabinets with cameras, lenses and delicate apparatus that are safely stored between expeditions.



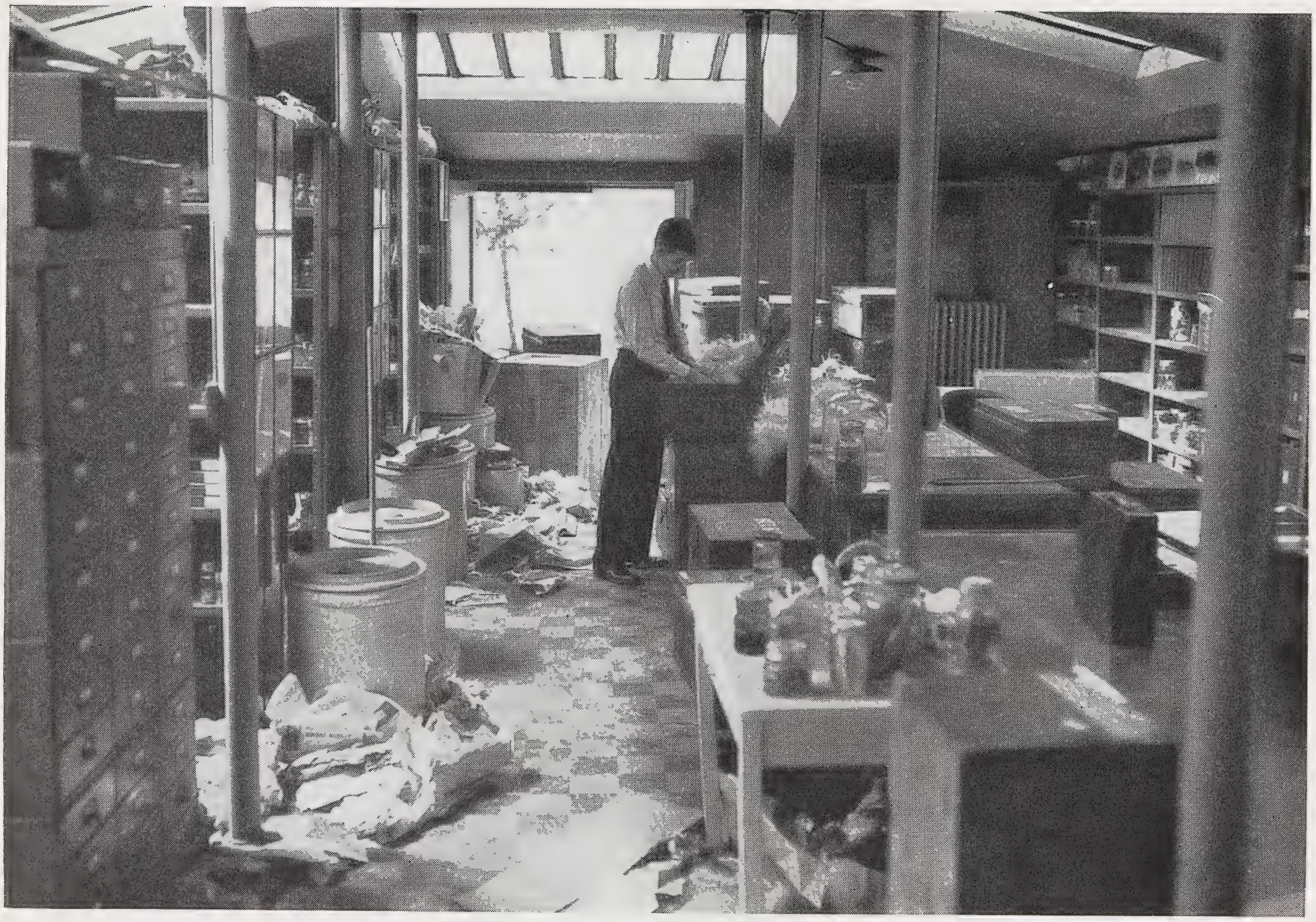
A new species of blenny, Stathmonotus corallicola *Beebe & Tee-Van, or "the carpenter's rule that lives in the coral."*



And this is the "Lyre-bearing sea-devil," or Lophodolus lyra *Beebe, a new species of light-bearing deep-sea fish.*



"Harrison's great-throated gulper eel," Saccopharynx harrisoni *Beebe. This new species of eel was named after Harrison Williams, patron of the* Arcturus *Oceanographic Expedition.*



When the time comes to pack the boxes and crates that must be taken on an expedition, the orderly laboratory is changed into a temporary shambles of instruments, wooden cases, jars, cans, old newspapers and excelsior, and the wonder is that nothing important is overlooked.

Here we find tiny motors, electric timing-devices, arc-lights, rheostats, magnets, leather driving belts, chains and gears, microscopes, cameras, and small peculiarly-shaped pieces of metal that must be lumped together under the carry-all name of gadgets. These, when properly arranged, form the time-lapse motion-picture camera that, photographing at the rate of one picture a minute for seven days, produced the film which shows on the screen in fifteen minutes the first week of an eel egg's life. This film, first projected at the Zoological Society's Annual Meeting in 1935, has had wide appreciation among embryologists and other scientists.

In contrast to the machinery for speeding up developmental scenes is a large heavy camera for slowing down motion. Zoological Society members may recall some of the motion-pictures of the flight of frigate birds photographed with this camera at the Galápagos Islands, which show the incredibly graceful and complicated motions of the wings of these birds when their movements are slowed down.

Thus in the dimness of cabinets rest these cameras, waiting for the opportunity to come when they will be removed and utilized in some distant field. If we look intently enough we can almost see in their eye-like lenses the light-glint of eager anticipation of the views and sights that will traverse their interiors at some future time.

In still other parts of the library we unexpectedly find odds and ends of diving apparatus and instruments that were used in the bathysphere descents, all carefully oiled and in readiness to be used in case we should want to extend the depth record in the ocean beyond the half-mile where it now stands.

Of the two smaller rooms of the laboratory, the westernmost contains the assemblage of transparent specimens familiarly known as the KOH collections, this being the chemical symbol of the principal agent used in clearing them. Here, stored in glycerine, is available for study a representative group of hundreds of fish and other animals so prepared that their scarlet-stained skeletons are easily viewed through tissues that have been made transparent. These KOH specimens, when placed side by side with untreated examples of the same species, enable us to have a complete view, without damage to the specimen, of the externals of the animal and its internal supports and structures. The delicate bony elements can thus be studied *in situ* without the necessity of dissection and consequent mutilation.

The shelves of the second small room are filled with boxes of insects and hundreds of spare bottles and vials that are constantly being called upon for preservation of new material, and with expeditionary shot-guns and rifles, ranging from modern hammerless three-barrelled guns to a large brass whaling-piece, incredibly heavy and made somewhere in the middle of the last century. Only one member of the expeditionary forces has ever had the courage to stand in back of this while it was going off. Whaling men of old evidently had shoulders of steel.

Farthest to the south is the laboratory room, half of its space devoted to storage of specimens and the other half to shelves of books, desks and two large, especially-built, glass-topped, laboratory and microscope tables with sufficient space for four to work.

In this room, with the exception of the larger bulky specimens that are housed in barrels, earthenware jars and metal canisters in storerooms in the Lion and Bird Houses, are the collections made on the expeditions of the department—materials from Guiana, Galápagos, Cocos, Gulf of California, Venezuela, the West Indies and Bermuda and the deep-sea trawlings and nettings from Atlantic and Pacific waters of the vessels *Arcturus, Gladisfen, Zaca* and *Skink.* In one section superbly pigmented butterflies and moths from the great rain-forests of the Society's station in British Guiana flaunt their brilliance, while close by in tall glass jars are black and purple-brown fish from a mile and a half below the surface of the sea. Microscopic skeletons of protozoa exist within a few feet of the skull of a giant sea-bass, and creatures from murky forests and swamp-lands stand next to sand-colored lizards from Baja California's deserts.

Although we have spoken thus of the large

Out of the chaos comes order eventually, when every type of supply that will be needed in the laboratory at New Nonsuch is carefully packed for shipment, checked off the list, and moves away on a Zoological Park truck toward a Bermuda-bound steamer.

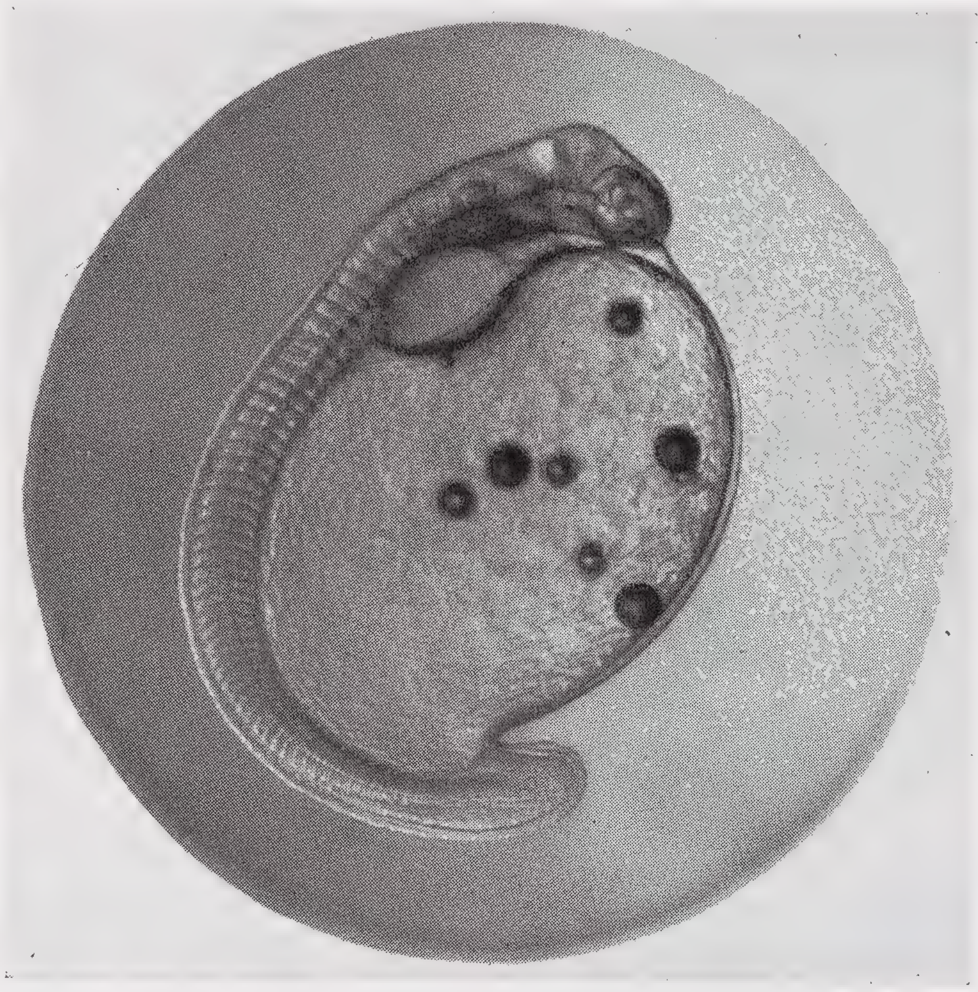
This is just a corner of the great KOH collection. There are hundreds of such bottles, each containing one or more fishes, carefully prepared by Miss Hollister so that their scarlet-stained skeletons are visible through tissues that have been made transparent.

collections in the laboratory, it must be remembered that the Department's expeditions are not primarily collecting ones and that for years we have maintained a position midway between the Zoological Park which exhibits living creatures, and museums which are chiefly repositories of dead ones. Our object is always to study the living or fresh specimens in the field and then to preserve what are needed for future study. Even this carefully selected collecting would soon overflow the laboratory. So whenever the specimens of any group have been studied they are presented to the American Museum of Natural History where they are preserved in perpetuity and are available for reference and study.

The collecting of specimens and field-notes and their installation in the laboratory represent but a fraction of what happens to fish or crustaceans or other animals before their secrets are exhausted and they are finally stored on shelves as proof of printed assertion. First of all, after reaching the laboratory, the animal must be identified and named so that we can have a handle by which it may be intelligently discussed. This requires a library of considerable size and the department's private library is an excellent one possessing the standard zoological texts, hundreds of volumes of reports of biological expeditions and all of the recent ichthyological and ornithological revisions and faunistic reports. Within cabinet drawers thousands of pamphlets on all sorts of natural history subjects are stored. On our shelves, cheek to cheek, are the twenty-two calf-bound volumes of Cuvier and Valencienne's *Histoire Naturelle des Poissons,* and next to them the fifty-two large tomes of the *Challenger* Reports, the rich fruits of the first great oceanographic expedition. Names of great ships stand out in gold letters on the backs of volumes, long after the hulls of their owners have disappeared, and thus are perpetuated on publications often of great zoological value such vessels as *Travailleur, Talisman, Siboga, Valdivia, Hirondelle, Albatross, Blake, Terra-Nova, Dana, Discovery* and *Michael Sars.*

With thousands of specimens and large numbers of volumes and references, some means of control must exist for keeping all these in order. Primarily this is done by shelving the various groups of animals in their zoological order and by catalogues and card-index systems. Thus, during all of the years of the department's activities, continuously numbered catalogues have been kept of photographic negatives, vertebrates, invertebrates, of type specimens and of the KOH collection.

A bottle of specimens newly arrived from the field may contain only a cryptic label saying "148 T-4"; but this, when reference to the proper catalogue is made, indicates that the specimens were taken on April 17th, 1936, from the fourth tow-net at Station 148 in a metre Michael-Sars plankton net towed for 1 hour and 20 minutes beginning at 3.45 P. M., at a depth of 500 fathoms or 914 metres from the yacht *Zaca* at 26° 48′ 40″ N. Lat., 111° 20′ 30″ W. Long., 13 miles NNE of Ildefonso Island, Gulf of California. In many cases much more information relating to salinity of the water, temperature, weather conditions, type of bottom, etc., may be included in this one reference.


The time-lapse motion picture camera photographed this eel egg 2 millimeters, or less than 1/12 inch, in diameter.

The laboratory also possesses a catalogue, produced during more than five years of spare time, that lists all of the known references back to 1895 to the littoral and shallow-water fishes of the western Atlantic from the Gulf of Maine to the River Plate, and of those of the eastern Pacific from the San Juan Islands to Peru and northern Chile. The author cards alone of this catalogue show that over three thousand papers have been read, some a paragraph long, others of many hundreds of pages, and the references to species checked off on a species card. This group of file cards, containing not only obvious forthright references but also obscure footnotes and indirect references in papers with misleading titles, has aided tremendously in handling the identification and life history notes of the fishes collected by the Department.

The focal points of the laboratory, where specimens and books and photographs and paintings and workers eventually converge, are the two large tables. Microscopes and microscope lamps, conveniently arranged typewriters, slide-rules, instruments for dissecting and measuring are gathered here to assist in solving the problem at hand. Finally on these same tables appear the manuscripts and illustrations of completed reports and printer's proofs of publications that represent the culmination of field work and notes and of the investigations and comparisons made within the laboratory.

For many years the laboratory of the Department of Tropical Research has functioned well, both for the Society's own staff and for visiting scientists of other institutions who have come to study our specimens and compare them with their own. Although it does not possess a door mat with "Welcome" on its face, neither is there a sign saying "No Admittance." Members of the Society and their friends will always find an open door and a cordial greeting whenever they are interested to see the results, both technical and popular, of the years of scientific endeavor of the Department of Tropical Research.

BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

Vol. xli JUNE 1, 1938 *No. 3*

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All pictures not otherwise credited are from the photographic collection of the New York Zoological Park and the Aquarium.

NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

Sample of Australian Snakes

Australia's reptilian fauna is peculiar in that it has many species of snakes and a great majority of them are poisonous—their toxicity ranging from that of the Little Whip Snake fifteen inches long, whose bite is scarcely worse than a bee sting, to that of the Giant Brown Snake whose fangs are half an inch long, or the Tiger Snake, whose venom drop for drop is said to be more deadly than that of any other snake in the world.

Two Tiger Snakes (*Notechis scutatus*), a Purple Death Adder (*Pseudechis porphyriacus*) and an Australian Copperhead (*Denisonia superba*) are new arrivals in the Reptile House. It has been more than twenty years since we had a Tiger Snake—a small specimen—and we have had only one Death Adder. This is our first specimen of the Australian Copperhead.

All four specimens have been placed on exhibition in the same cage and serve as an excellent sample of the beauty—and deadliness—of Australian elapines. The Purple Death Adder is particularly handsome, with a scarlet stripe on each side of its satiny, blue-black body.

Minnows Among Morays

Perhaps the most dangerous fish on exhibition at the Aquarium are the large green morays, *Gymnothorax funebris*. These great eels, some of them more than six feet long, possess powerful jaws and many sharp teeth. Although caught as food in some places they are feared by fishermen, for specimens of the size of those at the Aquarium could sever a finger or mutilate a hand with ease. In captivity they live peacefully with their own kind except for rare fights in which they employ their natural weapons against one another with devastating effectiveness.

For a long time a group of common killifish has shared the same tank with the morays, and last autumn some sheepshead minnows or broad killifish, *Cyprinodon variegatus*, got into the tank. Both these species enjoy complete immunity from attack by their predacious tankmates, probably because of their small size. The common killifish reaches about five inches in length, the sheepshead minnow two inches less. So audacious are they that they will even pick at large slices of fish held in a moray's mouth preparatory to swallowing. This momentarily presents the absurd spectacle of a tug-of-war between two fish, one hundreds of times bigger than the other.

The sheepshead minnows are apparently more or less completely at home in the moray tank because they spawned there this spring. Their eggs are heavier than sea water and become attached to submerged objects by means of minute adhesive threads. This is somewhat earlier than egg laying occurs in nature at this latitude, but the higher temperature (about 72° C.) of the tropical marine water at the Aquarium may account for the advancement of reproduction. The eggs developed successfully, and now several hundred young sheepshead minnows of various sizes swim among the morays.—J. W. A.

Two New Eagles

A specimen of one of the largest, if not actually the largest, eagles in the world has just been added to the Park's collection of raptorial birds. It is the Kamchatkan sea eagle, or Steller's sea eagle, *Haliaëtus pelagicus*.

The bird is native to northeastern Siberia and the Kamchatka peninsula, wintering through Japan and parts of eastern China.

In general appearance it is much like a large golden eagle, except that it has an immense bill, a cream-colored tail, and much larger feet than either a golden or a bald eagle. Its feeding habits are similar to those of the bald eagle; the bird feeds largely upon fish, and occasionally carrion.

Another interesting new eagle, which we have not exhibited for a number of years, is the vulturine sea eagle of South Africa, *Gypohierax angolensis*. The bird has an unusual habit—for a fish-eating sea eagle—of feeding also on a kind of palm nut.

An American opossum with five offspring old enough to be seen outside the maternal pouch is on exhibition in the Small Mammal House. For the next few months the young ones will still be small enough to make use of the pouch on occasion, and will be seen in and out. Unfortunately the nocturnal habits of the opossum damage its value as an exhibition animal, for it sleeps most of the day, and is most active only at night.

The birth of the young opossums created a special problem. The mother had to be transferred to a cage with very small mesh to keep the babies from crawling outside. In the past the keeper has sometimes had to search all over the building to collect young opossums which escaped from the cage during the night.

Publications of Interest

THE AMERICAN BISON. By Martin S. Garretson. 254 pages, 65 illustrations. New York Zoological Society. $2.50.

Naturalists, conservationists, travelers, explorers, collectors of Western Americana and many other groups of our people will welcome Martin S. Garretson's "The American Bison," a comprehensive, interesting and exciting story of a great mammal which came to the brink of extermination only to be rescued at the turn of the century by a group of public-spirited citizens, including the author himself.

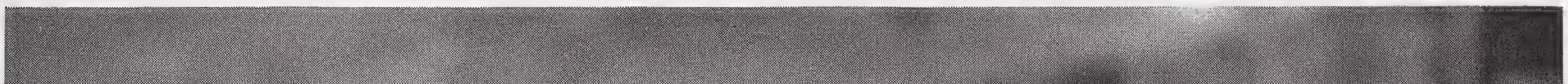
Written from personal observations, painstaking research and countless interviews with plainsmen, soldiers, Indians and scientists, this notable book now appears as a publication of the New York Zoological Society, beautifully printed and illustrated with an exceptional variety of photographs, drawings, and reprints of old wood cuts. It is most appropriate that this volume is dedicated to the late President of the Society, Madison Grant, who to the end of his long and useful life devoted his time and energy to American wild life, forest and scenery preservation.

The author is both a naturalist and historian. He has overlooked no important fact regarding the bison's origin and growth in prehistoric ages, its numbers, physical characteristics, habits and range in modern times, its importance to the Indians and to the white settlers of the Nation, its approach to total extermination through merciless and ruthless slaughter, its rescue from extinction and its present status in thriving herds under public care and supervision.

The American bison is a distinctive species on the North American continent. It is a much more impressive animal than its distant European cousin which resembles it. Mr. Garretson points out that 400,000 years ago the bison's forbears roamed both Asia and North America as well as Europe. Fossil bison have been uncovered below tundra in icy gravels of the North, and heads have been found with horns measuring forty to fifty inches between tips.

In historic times, on this continent, there were three bison, each designated by its respective range—plains, mountain and wood. The wood bison were larger and darker than the others. The mountain type was exterminated in the 'Sixties. The plains branch compose the large herds of today as well as the groups and individuals in small parks and zoos. The wood bison remnants survive in the great Wood Buffalo National Park in northern Canada. Scientists, it must be said, have never recognized but one species of bison, and since early colonial times the animal has been called "buffalo," although it is certainly not a buffalo. Here in America, the name probably grew out of the French "les boeufs."

When this continent was discovered, the bison range was one-third of its area. It extended from western New York, Pennsylvania and Virginia to Nevada and the Blue Mountains of Oregon, and from Great Slave Lake to the highlands of Mexico. Cortez in 1521 first saw the buffalo, or "Mexican bull" as it was called, and in 1540-42, the great explorer Coronado saw bison herds all along his route through the Southwest. Herds in the East were comparatively small because of the dense forests. So were the herds of mountain



Small frogs and fishes are the natural food of the common water snake, but these specimens at the Aquarium quickly learned to eat pieces of beef heart. The larger specimen was vicious when it arrived; now it willingly eats from the keeper's hand.

buffalo in the Rockies and beyond. The great herds were on the plains of the West and migrated generally north and south, although there were movements east and west.

Mr. Garretson's descriptions of the vast herds of bison on the move, their stampedes which when directed by Indians took them plunging over precipices to death, and their mass crossings of great rivers, are vivid, thrilling word pictures of scenes that can never be reenacted even in the motion pictures. He does not estimate the probable number of bison in the country before hunters and settlers began their destruction. There may have been ten billion head, he states, recalling an early estimate, but says this is probably far too high. General Phil Sheridan estimated 100,000,000 head on the western plains after the Civil War, but he thought this figure conservative. Buffalo Bill and eight Army officers in 1867 counted bison from daylight to four o'clock in the afternoon and their average estimates were 243,000. Horace Greeley thought there were 5,000,000 buffalo, but his observations were limited to his stage coach trip across the plains in 1859.

The bison, east of the Mississippi, were virtually exterminated by 1820, although in Wisconsin and Indiana a few were killed later. The last bison in Pennsylvania was killed in 1800.

West of the Mississippi, trade in bison skins, tongues and tallow was heavy in the fourth decade of the 19th century. In 1848, 110,000 robes and 25,000 tongues reached St. Louis, coming largely by boat down the Missouri River. Dr. F. V. Hayden estimated that between 1850 and 1860 about 250,000 bison were killed annually.

The great slaughter took place after the Civil War as settlers pushed westward, as the railroads were built and as the Army sought to subdue the Indian tribes. The herds in the southern portion of the plains region were practically wiped out by 1878, although a few were killed in the South as late as 1889.

The slaughter was so ruthless, so wanton, so horrible, that thoughtful men sought protection by law for the hapless animals. In Texas, in 1875, a statute might have been enacted had General Sheridan not expressed his ambition to control the Indians by saying: "Let them (the hide-hunters) kill, skin and sell until the buffalo is exterminated, as it is the only way to bring about a lasting peace, and allow civilization to advance." In 1874, in Congress, Representative James A. Garfield said the Secretary of the Interior had declared that he would rejoice so far as the Indian question was concerned, when the last buffalo was exterminated. Had these men been able to foresee the "dust bowl" of today, they might have passed some laws to save some of the range for the Indians and their buffalo.

The northern herds met the same fate as those in the South. "The last year of the buffalo was 1883," Mr. Garretson says. The herd went into Canada that year, never to return. Cree Indians and Sitting Bull and his Sioux killed what animals the hide hunters missed.

This thrilling book tells us stories of famous buffalo hunts, such as those of Grand Duke Alexis in January, 1872, the "Millionaire Hunt" of 1874, and President Arthur's expedition of 1884. It tells of great hunters, especially "Buffalo Bill" Cody, who clinched his title in a killing contest with Bill Comstock. The wager was $500 a side. The hunt was to continue for eight hours. The winner was to take the money and the title "Buffalo Bill." Cody killed 69 bison and Comstock 46. While hunting for the Kansas Pacific Railroad, Buffalo Bill Cody killed 4,280 buffalo. His last bison was killed in 1910 on "Pawnee Bill" Lillie's ranch in Oklahoma.

Other fascinating chapters cover the importance of the buffalo to the Indians, and the settlers, and there are most interesting discussions of hide hunting and the by-products of this industry, such as bones which were gathered up and shipped away by trainloads for fertilizers and carbon manufacture, the wool which men tried unsuccessfully to make into cloth, the droppings or "chips" which were valuable for fuel in the treeless country.

Then there are the final chapters faithfully recording the activities of Charles Goodnight, C. J. (Buffalo) Jones, Michel Pablo, Charles Allard and others who caught calves and reared private herds to become nuclei of the fine Government herds we have today. Here are discussed the tremendously important activities of Dr. William T. Hornaday, who made the remarkable survey which resulted in his report, "The Extermination of the Bison," printed in 1889, and which awakened the country to the fact that the buffalo had all but vanished from the face of the earth. Here is the account of Dr. George Bird Grinnell's fight in "Forest and Stream" to save the buffalo in Yellowstone National Park. Here is described the rise of the American Bison Society with full credit given to Dr. Hornaday, Edmund Seymour, Austin Corbin, Ernest Harold Baynes and others who worked ceaselessly in planning and raising funds for the establishment of Government herds in national parks and game preserves.

The exceptional achievement of the Canadian Government in saving bison is given proper emphasis, and the story of its work is brought down to the recent transplanting of plains bison in the Wood Buffalo Park, a 17,500 square mile reserve in the North Country.

The magnificent achievements of the friends of bison are best reported in cold figures. In 1900, when at lowest ebb, there were 1,091 buffalo in the world. In 1933, there were 21,701 reported in the census taken by the American Bison Society; and it must be remembered that every year the larger herds are reduced by humane methods to keep their numbers within the grazing limits of their ranges.

The bison are safe now. But the days of the great herds are long past. And the men of the old West who saw them sweeping over the plains are no longer young nor numerous. The time has come for the story of the buffalo to be set down in permanent form. Mr. Garretson, long recognized as the best equipped man to accomplish this task, in writing his splendid history of the noblest American animal, has performed a public service for which many coming generations will be profoundly grateful.

HORACE M. ALBRIGHT
Superintendent Yellowstone National Park 1919-29; *Director, the National Park Service,* 1929-33.

"For a complete knowledge of our western history, this book is indispensable."

—PAUL ENGLE, *Cedar Rapids Gazette*

THE

AMERICAN

BISON

by

MARTIN S. GARRETSON

Secretary of the American Bison Society; Curator of the National Museum of Heads and Horns.

$2.50

● Reviewers have extended a uniformly cordial welcome to this history of the American Bison written by a member of the New York Zoological Society's staff, and published by the Zoological Society. It is magnificently illustrated by 65 halftones and linecuts.

"[Mr. Garretson's] book will have to be included in every man's library, or the library will be incomplete."—E. CARL SINK, *Winston-Salem Journal and Sentinel.*

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PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Forty volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XXII are complete and indexed. Volume XXIII will be issued during 1938, in quarterly parts. *Zoologica* is sent to members on request.

[*Zoopathologica,* Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica. Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report, Zoologica* and *Zoopathologica,* as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager, Zoological Park,* 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

Clark and Fritts, New York, Printers.

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July-August, 1938

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.

AUG 5 1938

A corner of the campus of West China Union University, through which Pandora was acquired for the Zoological Park

BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

Published by the New York Zoological Society

Vol. XLI July-August, 1938 No. 4

How "Pandora" Came to the Zoological Park

The Baby Giant Panda Is the First of Many Specimens that May Come Through West China Union University

DEAN SAGE, JR.

BECAUSE the acquisition by the New York Zoological Society of our young giant panda, "Pandora," came about in such an interesting fashion, and because the method is one that holds many promises for the future, I feel that the members of the Society would like to know what the circumstances are and what plans we have for the future.

To set down in sequence the chain of events that led to the arrival of Pandora at Newark Airport on Friday, June 10, and her installation a few hours later in the Zoological Park, I shall have to go back to the summer of 1934, when I led an expedition on behalf of the American Museum of Natural History into western-most China to collect zoological material in the beautiful Snowy Mountains that form the border between China and Tibet.

We had traveled nearly 10,000 miles by rail and boat to reach the coast of China, and had then traveled an additional 2,000 miles by boat up the Yangtze River and overland to the ancient walled city of Chengtu, capital of Szechwan Province. Our stopping place in Chengtu was the shady, green campus of West China Union University just outside the city walls, and anyone who has traveled extensively in China, particularly during the fierce heat of mid-summer, will appreciate how delightful and hospitable that campus, with its friendly missionaries, was to our travel-weary selves. This was my first contact with the University, but the welcome I found there and the invaluable help given me in preparing my expedition for its field work in the interior were as generously and freely proffered as if we had been friends for years.

Our expedition, as I have said, was for the purpose of making a general zoological collection, but we also hoped to be lucky enough to get a giant panda. I say *a* giant panda because up to that time giant pandas were exceedingly little known, only two, in fact, having previously been shot by white men. We did procure several giant pandas, two of which have been mounted and will soon be on exhibition at the American Museum, but that is beside the point of the present story.

For such an expedition as ours, bound for the mountains of the Chinese-Tibetan borderland, Chengtu was the jumping-off place. Beyond Chengtu lay the great wilderness of central Asia, before penetrating which, all kinds of arrangements must be made. Inasmuch as travel was to be on foot, coolies had to be engaged to carry our entire outfit. Food had to be bought and all our paraphernalia had to be carefully made up into loads of the proper weight and balance for coolie travel. In addition to this, permits had to be obtained from the military authorities, a cook and an interpreter had to be found, and the dozen and one other arrangements made that are necessary for the launching of an expedition into the field. Without the help

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of the missionaries of West China Union University, none of this would have been possible, and I can safely say that I owe a large measure of the success of my expedition to the patient and untiring efforts of these generous people. During the time which I spent on their campus I had a good opportunity to study the operation of the University and to learn what an invaluable service was being rendered by this group of workers in a far off land.

Eight missionary societies in the United States, Canada and Great Britain founded and support the University with additional financial aid from individuals, philanthropic foundations and the Chinese Government. It operates on the principle that men's bodies, as well as their souls, require care, and thus its work embraces four departments: arts, science, medicine and dentistry, and religion. Inconceivable as it may seem to us of the western world, West China Union University is the only educational, medical and social service center in the whole of Szechwan province—a province the physical size of Germany, with a population of more than 60,000,000 persons!

The train of events that lead to the arrival of Pandora started over a lunch table one raw March day this spring. Dr. Edward R. Cunningham of the University faculty had been visiting me and we fell to talking of the various activities of the University and of the Zoological Society. The thought occurred to me that it was a pity that there should be educational institutions, located on opposite sides of the globe, each one working for many of the same ends, and each of which had many things that it could provide to the other, without there being any connection between them. It was but a step to the next thought—Why shouldn't there be a connection, and why shouldn't these institutions join forces in a cooperative educational venture? The University, I knew, was situated at the very edge of one of the richest areas for the collection of scientific material of all sorts in the whole world. They also had a trained staff capable of making collections. In addition, there was the invaluable factor of their close and friendly relationship with the central government, which would enable them to export materials collected. All this work could be done by them at low cost and the fruits of a rich and hitherto unexploited field could be made available to scientific institutions in this country, which had neither the financial means nor the political influence neccessary for sending out expensive expeditions to carry on a work which could be so much better done for them by the University.

On the University's side, there were many practical advantages to be gained by forming such an association. There would be an opportunity for the development of their science department. In time, this might mean the founding of a natural history museum, an arboretum, perhaps even a zoological park. In addition, to compensate them for their work and their small monetary return, there were many kinds of educational and scientific material such as films, technical journals, lantern slides, current scientific books, scientific instruments, etc., which the institutions of this country might be able to furnish them, and benefits of many other kinds which could be rendered.

The scales seem to balance pretty evenly in favor of all parties to such an arrangement, and the immediate upshot of my luncheon with Dr. Cunningham was a long letter to the University outlining my ideas and tentative proposals on the subject. In my letter I did not forget to mention that the one thing I wanted first of all was a live giant panda cub, if possible a pair of cubs, male and female. It had been, ever since my return from China, my desire to obtain one of these animals for the Zoological Society, and although efforts on my part had thus far been unavailing, I felt that here at last was the opportunity that would materialize. An enthusiastic response to my letter was not long in coming. A committee had been formed to consider my proposition and a detailed plan of cooperation had been drawn up and sent me. Last, but not least, the University would try to get me a giant panda. I need hardly say that I awaited each successive China Clipper with the greatest anxiety and eagerly scanned the mails for a letter that would tell me of a panda's capture. At last it came, four exciting pages from Frank Dickinson of the University faculty, telling me that a female cub had been acquired and would in due course be shipped to me.

From Dickinson's letter and from Roy C. Spooner, also of the University faculty, who brought the animal across the Pacific, I have a fairly complete story of Pandora's acquisition. Upon receipt of my letter asking for a giant

The pictures at the top of this page are typical of the giant panda country of western China through which the Sage-West China Expedition passed in the summer of 1934. It is a rugged and at times almost impenetrable wilderness where the bamboo, the favorite food of the panda, grows over vast areas. The scene at the left is a view up the valley of Yen Hsui Gou. At the right may be seen the peaks of the Snowy Mountains from the bed of a stream in a valley between the ranges.

The easiest way to penetrate the giant panda country is by means of the streams. Above, left, is such a mountain stream, overhung by bamboo and rhododendron. Such vegetation is typical at an elevation of 6,000 feet. Above, right, is the house of a farmer, where the Sage Expedition stayed. Below are two bleak scenes in the panda country from high altitudes. In areas such as these the blue sheep, or burrhel, has its range. These are winter views of the home of the giant panda.

panda, word was sent out by the University to native hunters in the mountains that they were anxious to obtain a *Beishung*—white bear—the native name of the giant panda. The area west of Chengtu has become highly panda-conscious in recent years since collectors have gone in after specimens, alive or dead, and word that a price will be paid for an animal travels quickly. Soon thereafter Mrs. Dickinson went on a sketching trip to Kwanhsien, a village about sixty miles from the University. She was hard at work when a Chinese woman approached and told her that a baby giant panda had been captured some distance to the westward and was being brought to the village. Needless to say, Mrs. Dickinson started the wheels going at the University, the native who had the panda was found, and the little animal was acquired by the University. She spent some three weeks on the campus at the Dickinsons' home where she became very much of a pet, and was by them nicknamed "Pandora." As soon as possible arrangements were made to send Pandora by plane to Hongkong and thence across the Pacific by boat with Dr. Spooner who, with his family, was returning to America on furlough.

It sounds easy, written out like that. A native brings in a giant panda and you buy it; then you put it on an airplane, and a steamer—and there it is, before you know it, in the United States. Actually the working out of such a schedule required an astounding amount of labor and wire-pulling and it was only through the utmost expenditure of good-will and personal interest on the part of our friends at the University that it was accomplished. I have a long letter from Dickinson recounting the steps that were taken to get clearance papers for Pandora before 7:15 on the morning of May 18 when a little four-seater China National Airways plane took off from Chengtu and started her on her long journey to Hongkong. It is too long and too involved even to summarize here, but in order to get the papers Dickinson corralled the three foremost officials of Szechwan province at 4:30 o'clock on the afternoon before plane day, showed them Pandora, and at 6 o'clock the next morning got the papers from the Commissioner of Education, who was sitting on his verandah in his dressing gown waiting for him.

On May 21 Pandora sailed from Hongkong on the S. S. *President Cleveland,* in the care of Roy Spooner. She arrived in San Francisco on Thursday, June 9, where she was met by Dr. Blair and myself, and we immediately put her aboard an eastbound United Airlines plane which landed at Newark the following afternoon.

Pandora is the third giant panda brought alive to the United States—Su-lin and Mei-mei, acquired by the Chicago Zoological Society, preceded her—and for her acquisition we owe much to the West China Union University. Debts of similar importance I feel sure we will incur in the future, as our exchange arrangement begins to function, and I trust that we may acquit them with promptness and fullness.

Head down, shuffling along at her usual easy, waddling gait, Pandora has an outing on the grassy lawn of Baird Court. She did not misuse her liberty by trying to run away.

Pandora in Her New Home

The Baby Giant Panda Has Quickly Settled into a Routine that Includes Plenty of Time for Sleep

W. Reid Blair

After eight weeks of exhibition we can report that our young giant panda is apparently in perfect health and is steadily gaining weight, at the rate of approximately two pounds a week.

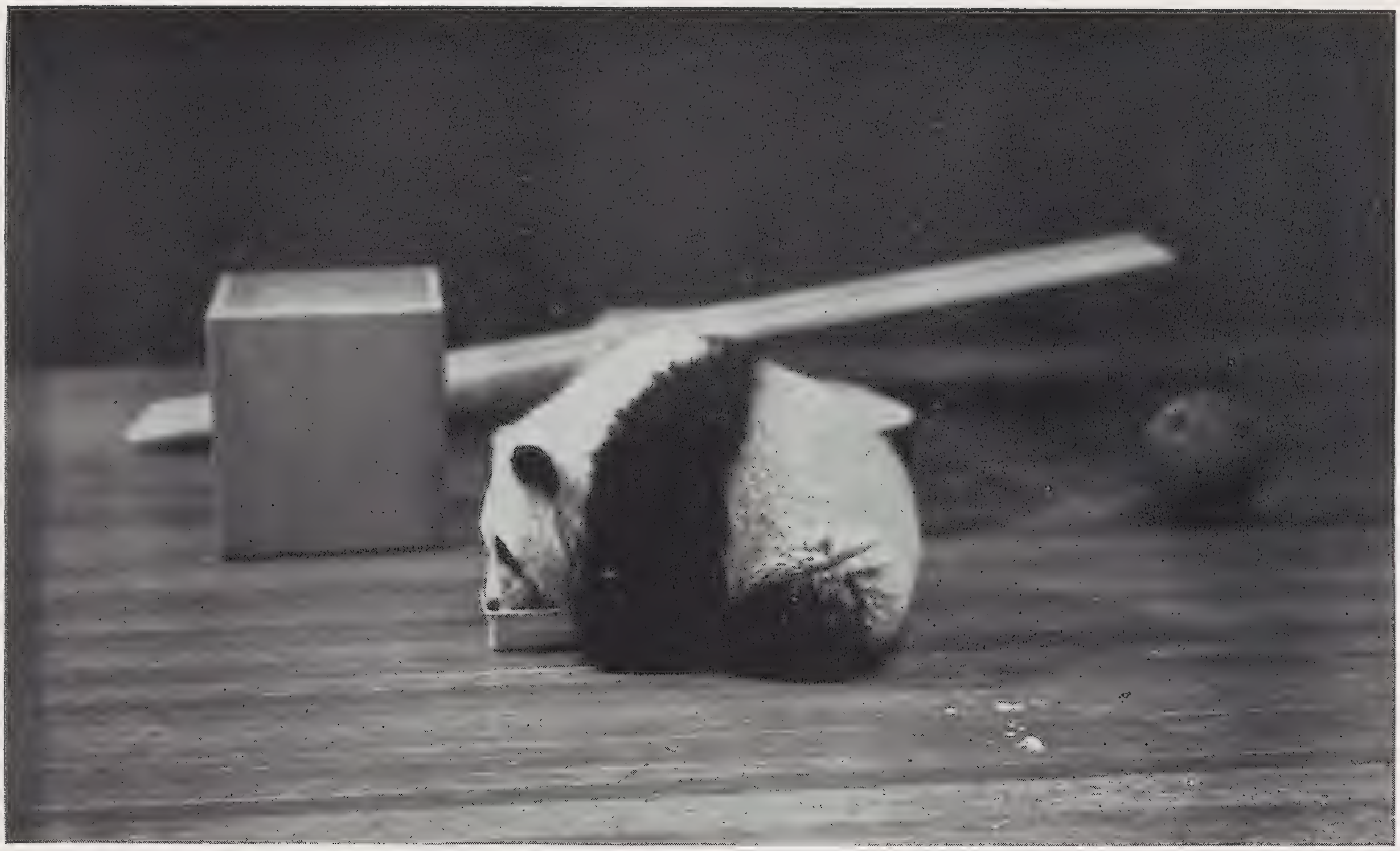
Fears about the diet of an animal that in its native mountains of China is reported to eat nothing but bamboo have now disappeared, for up to the present we have found nothing, among all the kinds of food we thought it advisable to offer her, that Pandora will not eat with eagerness.

Nor have the few unusually hot and humid days during the past two months seemed to cause the animal excessive discomfort, although they must greatly exceed the temperatures to which pandas are accustomed in the wild.

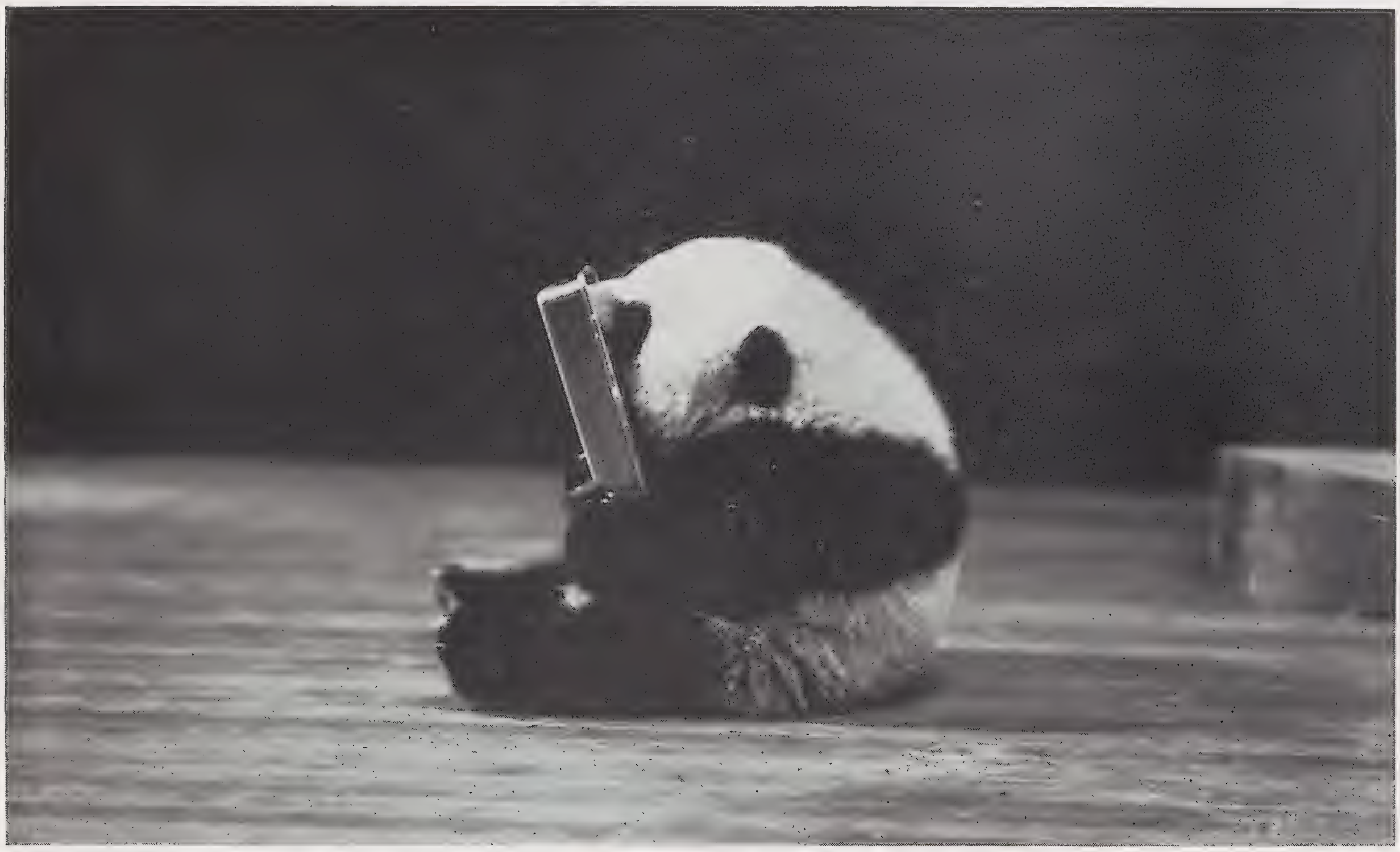
Through them all, hot days as well as cool, Pandora has pursued the routine which she quickly adopted when she was installed in her roomy quarters in the Lion House. After each of her four feedings she sleeps for an hour or two, comfortably sprawled or curled in a dark corner of her compartment, and then she shuffles about, climbs or plays industriously until time for the next feeding.

From the standpoint of our visitors, Pandora has proved to be an almost ideal exhibition animal. The public, perhaps, would prefer that she play all day and sleep only at night, but her play periods are sufficiently long that few visitors do not have a chance to see her trying to sit down on a rubber ball, struggling clumsily with a wooden box, or slipping and sliding on the runway to a low platform. Her antics are varied and repeated so tirelessly that we can understand the comment of one of the patrolmen assigned to the Park, who after a Sunday on which visitors were very numerous, reported:

"Thirty thousand people asked me the way



1 *When Pandora is given her morning meal of milk, egg, Pablum, honey and fish liver oil, she begins by getting as much of herself as possible in the pan.*



2 *The next stage is to pursue the last elusive drops into the corners of the pan, and this she does by picking it up and licking it with great energy.*

3 *Finally, when the pan has been licked clean and dry, Pandora rolls over on her back and pretends that some of that delicious breakfast can still be found.*

4 *"All worn out" might well be the title of this picture, to finish the breakfast series, but actually Pandora is simply resting before deciding what to do next.*

to the panda yesterday. Two men wanted to know where the okapi was, and a woman said she'd always wanted to see an aard-vark."

Pandora arrived at the Zoological Park on Friday afternoon, June 10, at 5:15 o'clock, after an uneventful flight from San Francisco. She was turned over to Mr. Dean Sage, Jr., and myself, by Prof. Spooner of the faculty of the West China Union University when we met him aboard the S. S. *President Cleveland* in San Francisco. We were able to catch an east-bound plane almost immediately.

The plane's first stop was at Salt Lake City, where it landed at five minutes before midnight. Despite the lateness of the hour there was a crowd of a thousand persons at the airport, all hoping to get a glimpse of the animal.

We felt that such interest deserved to be rewarded, and so, during the twenty minutes of the stop, Pandora was placed on a truck, in her traveling cage, and paraded along a fence where the visitors were lined up. The front of the cage was of coarse wire, and when a flashlight was turned on her she could be seen perfectly.

The arrival the following day at Newark Airport was celebrated by innumerable photographs, and then Pandora was put in an automobile and brought to the Park.

Confinement in a rather small traveling box had not made the panda unusually restless, although for some minutes after she was released she rolled on the floor and scratched against the bars. Then she settled down to a survey of her new quarters.

During the first twenty-four hours here she was under constant observation. An attendant from the Hospital was on duty until midnight Friday night, when he was relieved by another keeper. They reported no difficulties, and, indeed, none were expected. The course screen front of the cage later was sheathed with galvanized iron at a height that made it impossible for the animal to climb and the need for watchfulness was ended.

Because of the experiences of the Chicago Zoological Society with two young pandas, Su-Lin and Mei-Mei, as well as reports from Dr. Spooner on the regimen that had been followed during the voyage across the Pacific, it was not difficult to establish a diet that seems to agree with Pandora quite well.

At 6 A.M. she is fed milk, one egg, Pablum, honey and a small amount of fish liver oil.

The noon feeding consists only of milk.

At 2:30 P.M. she receives the juice of one orange in water and honey.

At 5 P.M. the morning meal is repeated.

In addition, green corn stalks, willow sprigs, celery, lettuce, Swiss chard, mangel tops and a baked potato are placed before the animal at night and she takes to them readily.

A careful record of Pandora's weight is being taken at intervals of a week. Her record so far is:

June 13.	34.98 pounds.	
June 20.	37.18 pounds.	Gain: 2.20 pounds.
June 27.	39.82 pounds.	Gain: 2.64 pounds.
July 5.	43.34 pounds.	Gain: 3.52 pounds.
July 11.	44.66 pounds.	Gain: 1.32 pounds.
July 18.	46.86 pounds.	Gain: 2.20 pounds.
July 25.	48.62 pounds.	Gain: 1.76 pounds.

Full-grown male pandas apparently attain a weight of about 300 pounds, but it is doubtful if females ever become so large. Incidentally, ten out of eleven pandas of which we have knowledge were females. Records of growth from babyhood to the adult state are not available, but at the rate Pandora has been going, it is probable that she will reach her maximum size in less than two years.

Her weight when captured was not taken, but while she was still in Chengtu awaiting shipment to the United States she weighed about 24 pounds—only half her present weight. Such rapid growth is an animal is astonishing, and far in advance of bear cubs, for instance.

The utmost care is being taken in the sanitation of the panda's compartment. It is washed down with water daily, and each week it is thoroughly scrubbed with disinfectant. The animal's bed is a thick pile of sterile, dehydrated, shredded sugar cane which is frequently changed.

By taking such precautions we hope that we may be able for a long time to come to exhibit an animal which is not only extremely interesting zoologically, but by its appearance and actions has immediately become a favorite with visitors.

Observations at the Marine Studios

Near St. Augustine, Florida, a Radical Departure from the Standard Type of Aquarium Has Been Made

C. M. BREDER, JR.

PUBLIC aquaria long ago reached such a standardization of treatment and presentation of material that it is indeed refreshing to be able to discuss a venture that departs radically from current practices. The Marine Studios, a brain-child of Mr. Douglas Burden, a trustee of the New York Zoological Society, has been taking form eighteen miles south of St. Augustine, Florida, for the past year. The scheme, born some ten years ago, was worked out in detail with Count Ilia A. Tolstoy and a group of associates including engineers and naturalists.

Basically the idea consists of having as large an enclosure as possible arranged so as to present the maximum convenience for submarine photography. Actually the working out of the plans developed into two tremendous aquaria, the like of which the world has never seen before. One is roughly rectangular in form and measures 100 feet by 50 feet and is 18 feet deep. The second is circular in form, 75 feet in diameter and 11 feet in depth. They are connected by a flume and both are supplied by water from the nearby ocean. This water is pumped to the aquaria from pipes laid in the ocean bed, the coquina sand of the latter acting as a natural filter. Each tank is built flat on the ground and surrounding it is a shell so arranged as to form a visitors' gallery between the aquarium walls and the outer shell. There are some 200 portholes, or rather glass windows through which visitors may peer at the contents of the tanks. These windows are ingeniously arranged at various levels and some are even placed in the bottom of the aquaria so that a crab's eye view may be obtained. A promenade allows visitors to see the exhibits from above. Photographic requirements have been kept in mind throughout.

It was my good fortune to be able to preview this establishment long before the opening date, June 23 of this year. At the time of my visit, in February, there was still much to be completed. However, it was clearly apparent that here was something with great scientific possibilities. Mr. Arthur McBride, curator, was busily engaged in getting his laboratory into shape and was full of plans for interesting scientific studies to be made when the establishment was properly launched.

Even at that early stage, there were observations to be made in natural history. While I was there, the first porpoise captured was placed in the circular tank. Viewed from above, it looked just about the way porpoises generally do from shipboard, but when viewed from the aquarium windows the appearance was most surprising. It so happens that the writer of these words is supposed to be familiar with the mechanics of underwater locomotion, but even so, he was completely unprepared for the behavior of thoroughly submerged porpoises. They have a distinctly hobbyhorse "gait" that is not at all evident from above. The accompanying photographs give some idea of this. In all three the porpoise is actually moving in a horizontal direction! The apparent divergences from it are only photographically arrested phases of the porpoise "gallop."

It is believed these pictures are the first ever taken of a porpoise in action as seen from the standpoint of another porpoise. Because of the peculiar grayness of these photographs, a word of explanation seems appropriate. The pictures are neither under-exposed nor is the

How a harbor porpoise in motion appears to another porpoise is shown by this and the two succeeding photographs taken in the circular aquarium of the Marine Studios.

A side view of the porpoise gives another angle on the peculiar "hobby-horse" gait of the animal. This is the first porpoise to be established at the Marine Studios.

In this, as in the previous two pictures, the porpoise is actually moving in a horizontal plane. These are probably the first pctures of the kind ever taken.

A school of mullets seen diagonally from below. The disappearing effect of these silvery fish viewed against a background of clear water is extremely well marked.

A bit of "sea bottom" in the rectangular tank of the Marine Studios. The intruding mullet is strongly visible, as against the school which blends with the blue-green water.

Large tanks with windows set at various levels give an opportunity to see how a big shark, Carcharhinus, appears from underneath when it is in its normal prowling motion.

water turbid. The effect is caused merely by rendering such a subject in monochrome. The slaty gray of the porpoise back against the blue-green of nearly 75 feet of water reduces to just about the same shade of gray on a panchromatic film. The counter-shading of the porpoise, dark above and light below, when under the conditions in which it naturally lives, with illumination from above, gives the appearance of a uniform gray all over. That the water was adequately clear is evidenced by the sharpness of the shadows on the bottom of the tank. This is especially notable in the head-on view. Thus these effects are not due to poor photography but actually give as true a picture of a porpoise in side view, under practically natural conditions, as can be rendered in black and white. A school of mullet near the surface, as viewed from a low angle, give very much the same kind of effect. Even their bright silvery bodies do not glisten as brightly as one might suppose. Contrasting is the single mullet that darted into the coral reef picture, where, incidentally, he really does not belong. Here against a nearby background he stands out prominently and the effect resembles more nearly the conventional aquarium pictures where photographic detail is sought at the expense of normalcy of light direction and environment.

It should be pointed out that practically any effect can be attained at the will of the photographer, the one chosen here being an attempt to render as near normal contrast as possible.

The porpoise here shown, lonesome and puzzled at first, gave vent to intermittent mouse-like "squeaks" that were distinctly audible in the visitors' gallery. It is probable that not many people, naturalists included, have heard the call of a lost porpoise.

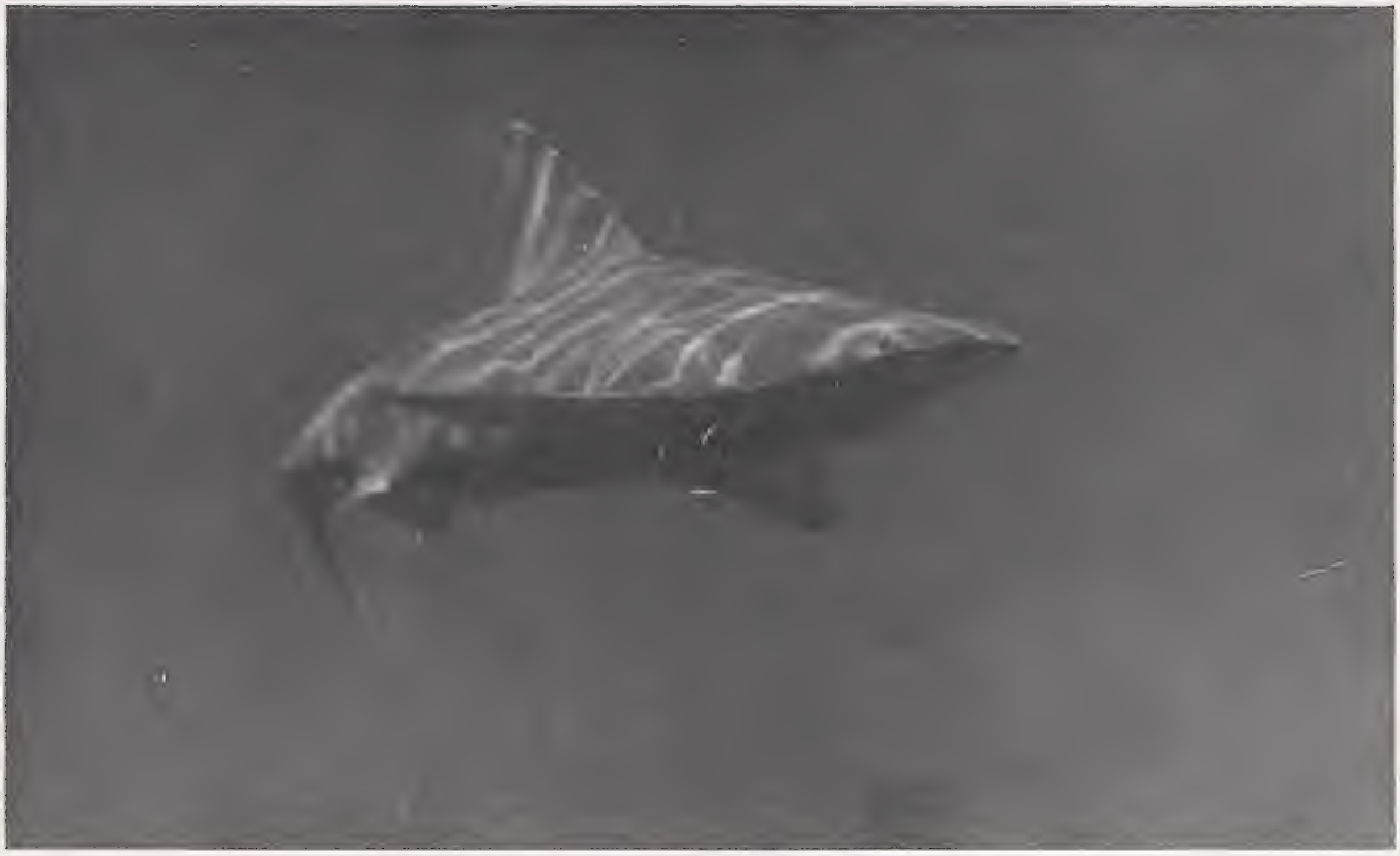
Being primarily interested in fishes, there was one item that developed from seeing these exhibits that gave an entirely new view of the environment of oceanic sharks and their habits. It is generally assumed that the typical gray sharks with their counter-shading are as little conspicuous as we have just seen porpoises to be when viewed laterally. So they are, as may be seen in the photograph of a large shark taken from a low position under 18 feet of water in the huge tank of the Marine Studios.

There are, however, certain conditions under which such fish become exceedingly conspicuous and stand out like the proverbial sore thumb. This is something that the present contributor, at least, was unaware of until opportunity was offered to see that "chunk" of the ocean made available at St. Augustine—in spite of the fact that sharks had swum over him while in greater depths by virtue of a diving helmet. When a shark or similar fish is a few feet below the surface in clear sun-drenched water that is rippled by a light breeze, the characteristic pattern of light bands plays over his back. These are identical with the patterns so often to be seen on sandy beaches under similar conditions.

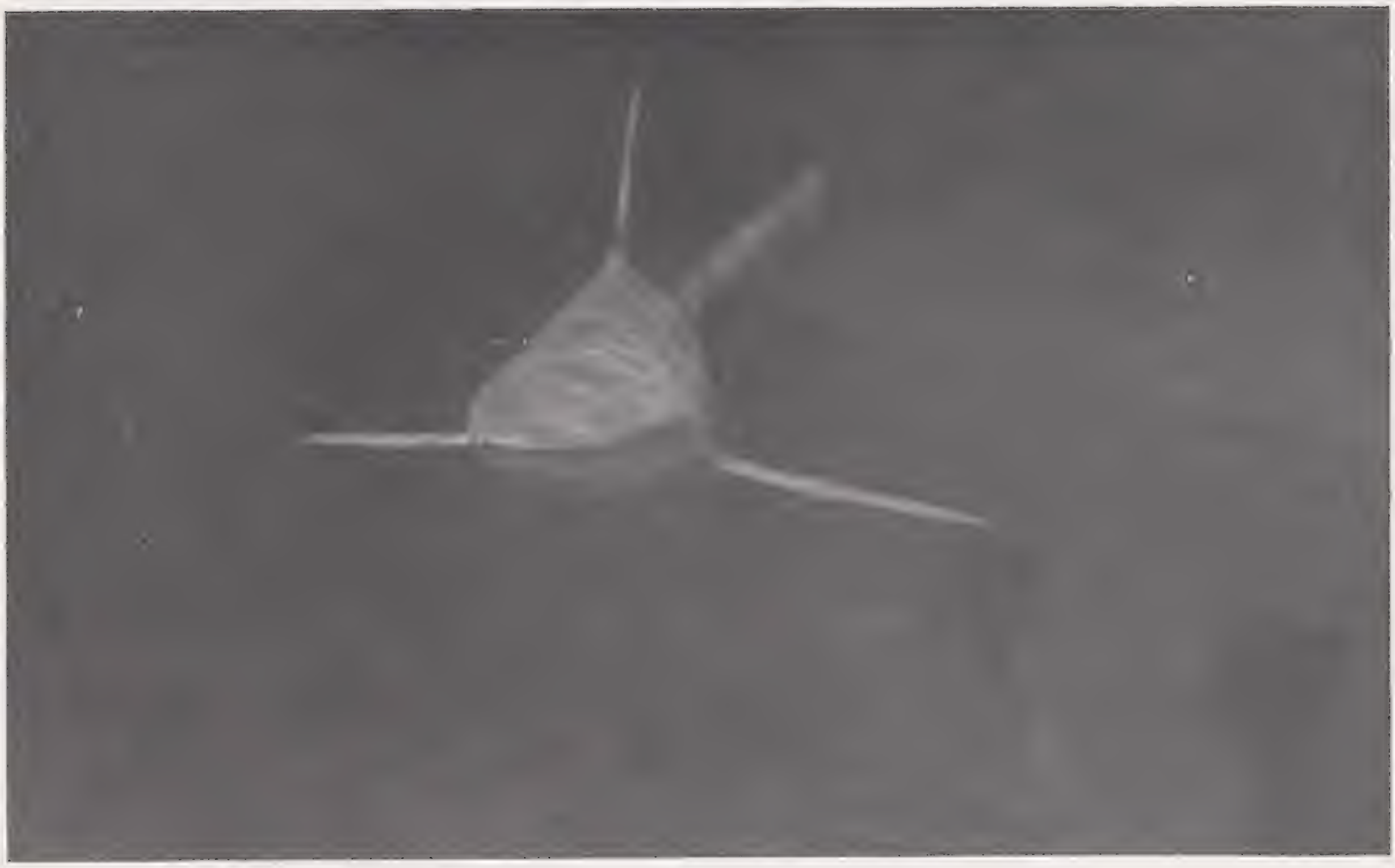
Moreover, if the water is properly clear, the passage of the light rays through it is invisible. Those that pass the shark are lost in the depths, only those impinging on the fish's back becoming evident. Thus the upper parts of the shark against the blue-green background become a living network of brilliant golden lines—the color intensified by the juxtaposition of the neutral background. These lines leave off exactly where the white under-parts of the shark commence, which, as in the case of the porpoise, take on the shade of the back by virtue of being in shadow. The photograph shows well the manner in which such a shark becomes an outstanding figure. His position must not be too far below the surface, since the spread of the light bands soon softens them so that they are little evident, as may be seen in the head-on view. As a measure of the clarity of the water in both these photographs, distant "windows" across the tank may be seen as dark rectangles in the gray cement wall.

One is moved to wonder what significance this condition has on the life and behavior of oceanic fishes. Suddenly when light and ripple are in certain relationship, they pass from a condition of merging at a little distance into the hazy blue background to one of extreme brilliance made up of a pattern of yellow-appearing lines, visible for a considerable distance. Not only is it a striking pattern, but it insists on dancing about whether the fish is moving or drifting, and all against a uniform background of static appearance.

Whatever may be the significance of this condition to oceanic fishes, their enemies or their prey, it does so happen that sharks are more apt to bask at the surface, with their dorsal fins protruding, when conditions are as described, than at most any other time. When in



Under certain conditions sunlight paints a scintillating pattern on the otherwise drab back of the shark. This is the same fish as in the picture below, and on Page 126.



A head-on view of the large shark. The conditions of light are different from those in the side view of this specimen and the pattern of light on the back is much fainter.

such a position this outstanding pattern is effectively destroyed. Could this effect be among the factors that determine whether a shark basks at the surface or remains below?

The Marine Studios, with these outdoor facilties, on an all too early preview, thus planted in the mind of one observer a number of points and questions not previously suggested by either field studies or the more conventional aquaria. We are sure that in addition to the educational and photographic values of this new venture, there is here a truly vast opportunity to make valuable scientific studies to which neither straight field work nor laboratory work lends itself in any appropriate sense. Writing from the vantage point of an old institution we cannot but extend our every wish for the full success of this pioneering activity in a field that for too long has undergone no basic change in method of approach.

We Exhibit the Rare Nyala

Discovered in 1847, This Is the First Time the Antelope Has Been Shown in the United States

Claude W. Leister

ANOTHER highly-prized animal, the nyala (*Tragelaphus angasi*), must now be added to the list of antelopes found in our collection and noted in the May-June, 1938, number of the *Bulletin.* While that account of our antelopes was in press a shipment of four nyalas was brought to New York by a local animal dealer, apparently the first time that this rare species has reached America. We have since purchased from this shipment a young adult male and a young female, now on exhibition in the Antelope House.

The bushbuck group of African antelopes, the so-called harnessed antelopes, includes some of the most strikingly-colored of the world's antelopes and the nyala is in many respects the most outstanding member of the group. It is not a large animal, the height at the shoulder being slightly in excess of forty inches, and the females are noticeably smaller. Like other harnessed antelopes both sexes are marked on the body by narrow, vertical white stripes, but the females show these harness-like markings to the better advantage. Our present female has thirteen stripes on either side, strongly contrasted against a light, mahogany-red ground color. Adult males are slate gray in color with brown legs. Young males are colored like the females. Thus a young male in the present shipment, about six or seven months old, is identical in color with the older females. The white stripes of the males are irregularly spaced. Some of them are incomplete and still others are so indistinct that they can be noted only when the observer is within a few feet of the animal. Several white spots about the size of a dime are to be noted on the lower haunches and the sides of the jaw.

The chief feature of the male is a mane or fringe of long hair which extends down the throat and then divides to run along either side of the belly, across the thighs to the tail. There is also a dorsal mane extending down the back. This mane of erect hair on the back and the fringe of hair on the lower part of the body add considerably to the apparent size of the animal. The graceful, lyrate horns are similar to those of the kudu and a chevron-like, white stripe is likewise borne on the nose. Female nyalas are hornless.

We usually associate antelopes with open plains but, on acquiring the nyala, we now have several species which do not inhabit the plains country. Our bongo is a forest-dwelling animal. The nyala lives, not in deep forests, but rather in bush country. It is one of the rarer African antelopes, never found congregated in herds but occurs in small groups in suitable and frequently widely separated localities from Zululand to Nyasaland.

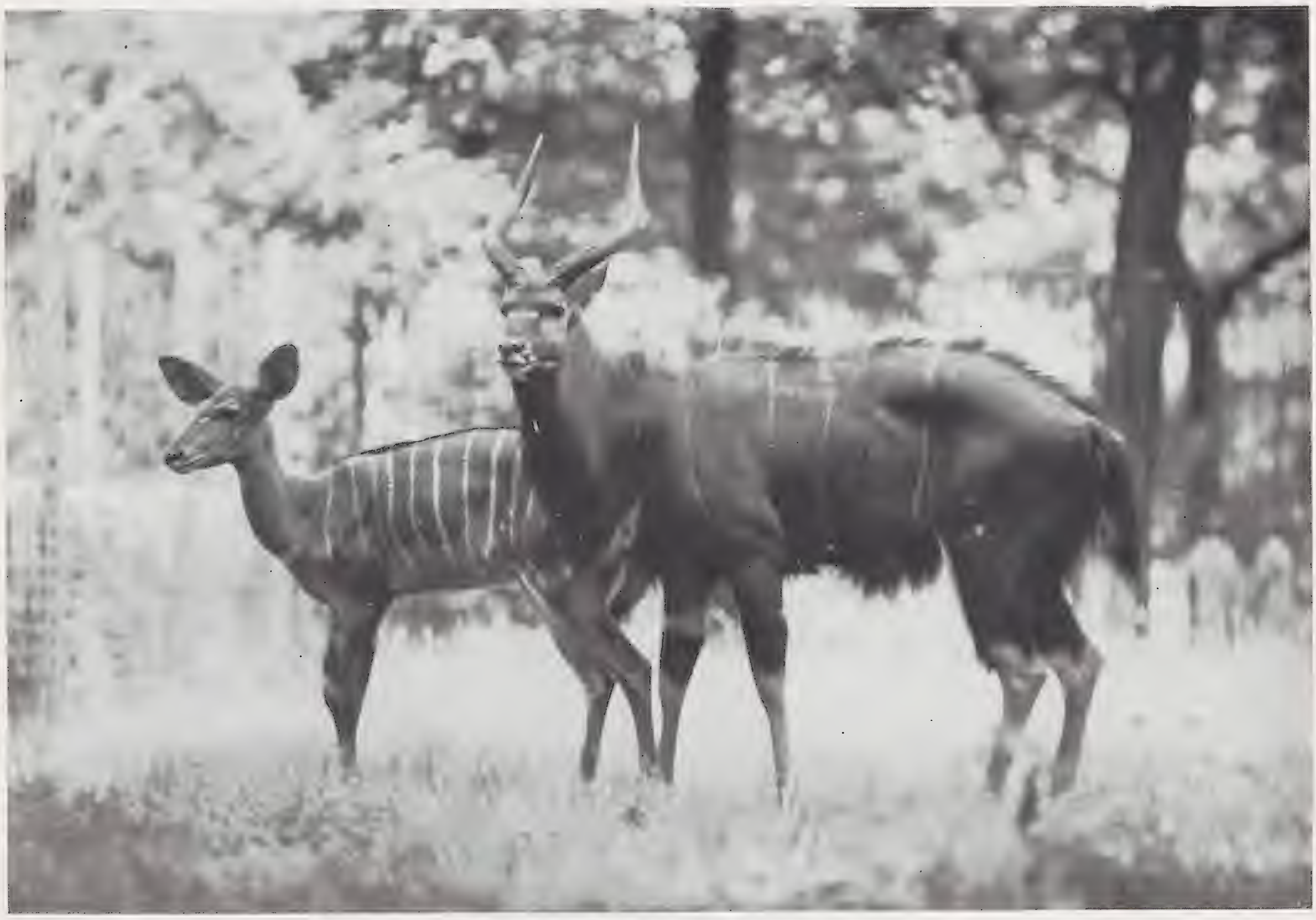
The nyala is more or less a browser, subsisting largely upon leaves, shrubs and fruits, and it also grazes to a certain extent. Some known foods are the leaves and bean pods of the acacias, leaves of the thorn tree and the so-called "kaffir oranges."

Typical nyala bush is extremely thick and tangled, practically impossible for man to penetrate unless he follows the low-vaulted animal trails which traverse it in all directions. Some other inhabitants of nyala bush country are red duikers, bush pigs and bushbucks.

The first nyala known to science was discovered by a traveler of the day, Mr. George French Angas, in Zululand in 1847. It was named *angasi,* not in honor of the discoverer himself, but for his father. Angas was unable to secure any specimens but his notes and sketches were vouched for by Dr. Gray and presented by him before the Zoological Society of London in 1848. The first actual specimens, secured by Proudfoot, were not received in London until 1851.

Our nyalas seem to be perfectly at home in their new quarters. Outside of the male making a vicious charge at one of the keepers assisting in the unloading, the change from shipping crate to corral was made without incident. The female possesses a fair share of the nervousness of her kind but this is ameliorated to a certain extent by the generally calm demeanor of her mate.

The summer of 1938 finds the Antelope House with the finest collection in its history. With such animals as the bongo, saiga, greater kudu, white-eared kob and the mountain reedbuck, our nyalas are in most unusual company. Two races of the giraffe and the rare okapi are quartered in the same building. We can be justly proud of this collection.



The "harness" stripes on our new nyalas are quite apparent in this picture, which shows the comparative visibility of the striping in the male and the female. Our young male has a magnificent pair of well-turned and perfectly formed, sharp-pointed horns.

What European Zoological Gardens Are Doing

A Few Notes on the International Ornithological Congress at Rouen and Visits to Several Great Animal Collections

Lee S. Crandall

A FEW days before I sailed, in late April, to represent the New York Zoological Society at the International Ornithological Congress and the meetings of the International Committee for Bird Preservation at Rouen, my telephone rang.

"Fairfield Osborn," said a familiar voice. "I envy you this trip you're making—you're going to see a lot of new ideas in zoos, and there ought to be some fine papers at the Congress. Why don't you write me a long chatty letter while you're over there? Cover the whole thing as well as you can, and we'll print it in the *Bulletin*. We can't all go to France this summer, but we'd like to hear what's going on."

The editor of the *Bulletin* had been pressing me, to the same effect. I promised. And I *did* manage to squeeze in time for one brief letter that began:

"My mind is jammed with impressions and my note-book is bulging—I can't see how either could possibly hold any more, but they must, as I still have England to do!"

But the human mind and note-books are capable of almost infinite expansion, and I came back with both well stocked. No further opportunity for letter-writing appeared, and I shall have to summarize the results of my observations in this article in somewhat less informal style than would have been possible through a letter.

To begin with, the sessions of the Ornithological Congress (which is held every four years and draws "bird men" from all over the world) were extraordinarily well attended by Americans. There must have been more than thirty, from museums, universities, zoological parks and conservation organizations. And almost every well-known European ornithologist was there. The sessions of the Congress occupied five days, from May 9 through May 13, and for most of the week following there were special exhibitions in Paris and a field trip to the former breeding grounds of the flamingoes in the Camargue.

Motion pictures and lantern slides, accompanied of course by talks in explanation or exposition, were fairly generally used throughout the meeting of the Congress. Several of them were simply magnificent. I should like to mention particularly the slow-motion moving pictures presented by Dr. M. Stolpe of Berlin on the flight of humming birds. Until this picture came along I doubt if any of us had dreamed of the technique the hummer employs in flight; the pictures showed plainly that the wing actually turns *upside down* on the back stroke, and that a complete stroke—forward and back— is made thirty times a second. That same timing of the stroke had been worked out in a film in this country, but I don't believe it showed that amazing upside-down posture.

Bird behaviorism is coming very much to the fore nowadays, and I think everyone was interested extremely in a film and explanation by Dr. K. Lorenz of Vienna on the psychology of the gray lag goose. Dr. Lorenz is an outstanding European behaviorist and I was glad of an opportunity to discuss his theories with him. He stands firmly for a definite behavior pattern for every action, but allows intelligent determination of what the action will be. In other words, the bird makes up its mind as to what it will do, but then it does it in accordance with an inherited pattern. All geese may not be frightened, but if they are, they all do the same thing!

Prof. Arthur A. Allen's sound picture on the voices of American birds was the second film on the program and was received with interest. Members of the Society will remember having seen and heard parts of this picture at our annual meeting three years ago. Later, at another session, Prof. Allen's associate, Mr. Brand, reported on the technique of capturing the voices of birds on sound film and we can hope that similar work will be undertaken abroad.

To indicate what use Europeans are making of the motion picture in their study of birds, I might mention a very fine film presented by H. Siewert on the display of the great bustard, and Dr. M. Stanislaus's presentation of an X-ray motion picture of the air-sac in birds.

The Society will be interested to know that our own contribution was well received. This was a series of twenty-five lantern slides on the display forms of nine species and subspecies of birds of paradise. Apparently no comparable series of photographs has been taken abroad, and the slides, in color, precipitated a warm discussion—inevitably—on the purpose of display.

Previous articles in the *Bulletin* have given some hint as to what the discussion is about. Briefly, the conservative opinion dating back to Darwin is that (I quote from the *Bulletin* of May-June, 1936) "the spring-time gyrations of male birds were undertaken purely for the delight of the females, each of which was supposed, in her own good time, to choose the most brilliantly colored or agile of the available suitors, thus insuring continuation of whatever charms he might possess."

This element of courtship is doubted by much respectable modern opinion and the theory is advanced that the purpose of the display really is to frighten away other males and to intimidate the female into submission.

My own feeling is that the female must be deeply moved and stimulated by the display, in accordance with the species habit developed through countless generations. Then, when the display is done supremely well, the female's feelings must be correspondingly heightened and instead of simply selecting the male that strikes her as the handsomest (the essence of the original Darwinian belief), it seems to me that she acts from an irresistible impulse to accept the male whose display approaches most nearly the highest standard of her race. This, of course, is the Darwinian thought—with a twist of interpretation.

I have summarized these various theories as a prelude to recounting an incident that occurred after my projection of our display slides. Since time was brief, I had avoided any commitment as to my own, or others', theories of the purpose of display, simply presenting the pictures as representing a variety of display forms. In the discussion that followed, I was questioned by Dr. E. Stresemann of Berlin.

"You did not mention it in your talk, but isn't it true that your photographs of the magnificent rifle bird in display were taken while a stuffed female was standing outside the cage?" he asked.

I said that it was true.

"That is what I wanted to be sure," he remarked. "And how did the male act after the display?"

"It displayed for ten to twelve minutes, at intervals, and then it was restless and perched on the side of the cage, trying to get out."

"Aha!"

Dr. Stresemann's interpretation of the meaning of displays is largely the same as mine and we saw the same significance in the point he brought out. While it is true that the magnificent rifle bird would display, at long intervals, without the presence of the stuffed female (which we had borrowed from the Museum of Natural History), it displayed almost immediately, and frequently, when the female was present. And after displaying, its attempts to get out of the cage obviously were made in order to reach the female and mate.

The Ornithological Congress was not exclusively devoted to sessions for the presentation of papers and documentary films. Time was set aside for a visit of the entire group to the neighboring village of Clères, where M. Jean Delacour maintains his magnificent private collection of birds and mammals. On that large estate exotic species can be maintained in a state of almost complete liberty because the collection is open to the public only on certain days, and on those days visitors are conducted through the grounds by guides.

The Delacour collection was—as I knew it would be—a paradise for an ornithologist. Many birds running at liberty were species I had never seen alive before—among them the African dwarf goose, the white-backed duck, the harlequin duck, Cape teal, Madagascar pochard, South American pochard and several species of shovelers, including the rufous South American species.

Bennett's wallabies, Chinese water deer and blackbucks roamed freely over the grounds. It was a charming sight, but one that we could never dare imitate. Even with the comparatively small, and certainly perfectly orderly crowd that we formed, the grounds were thrown into an uproar and the mammals particularly scattered in all directions as we approached.

M. Delacour has an effective way of displaying such small birds as hummers, sunbirds and pittas in what are, in effect, greenhouse aviaries. The aviaries are heavily planted with exotic plants and the public must inspect the birds through panes of glass. The impression is of a tropical forest, but as in a real forest, the birds are sometimes lost sight of because of the foliage.

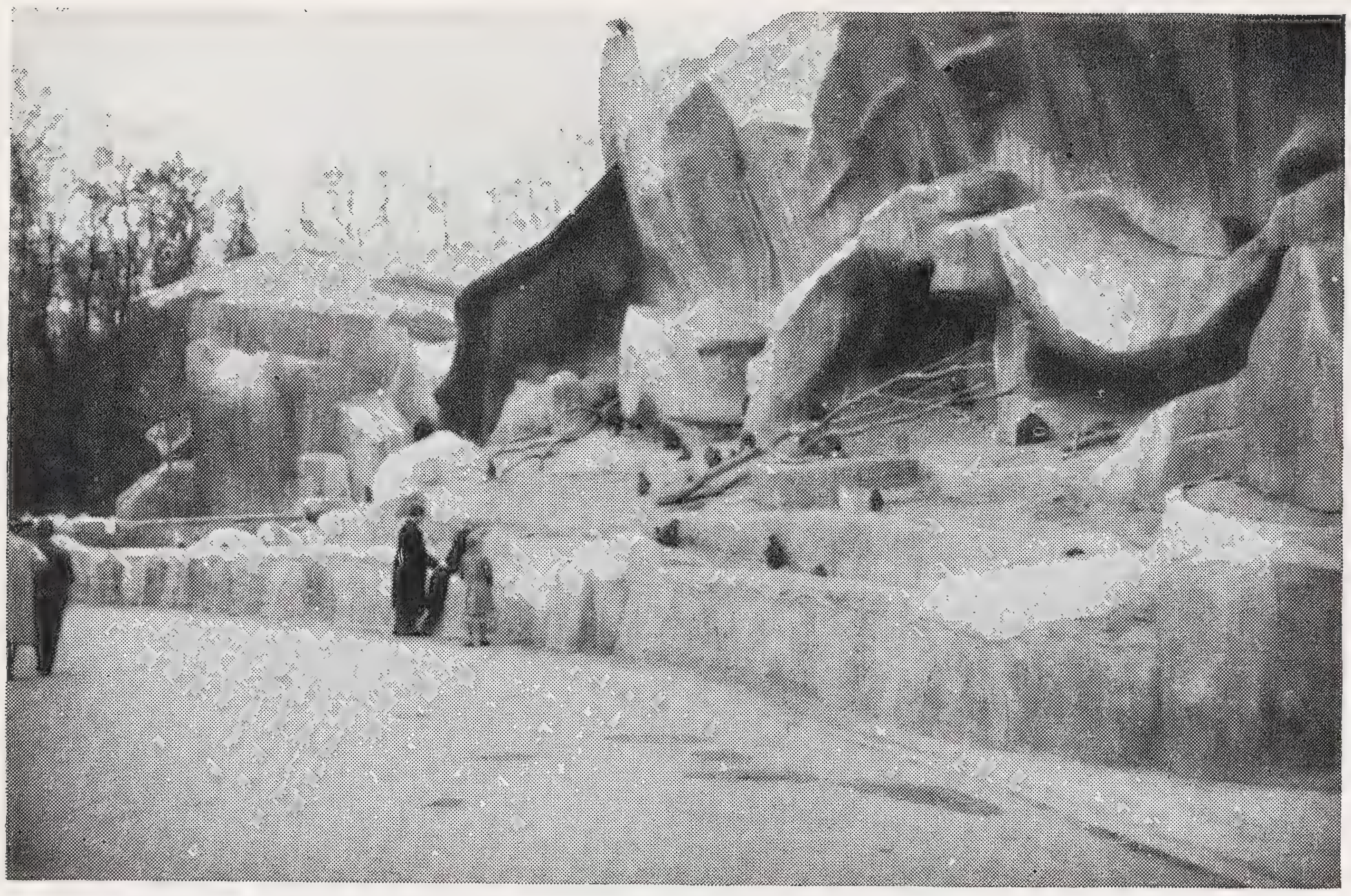
Clères possesses what is certainly the finest collection of pheasants in Europe, and is especially strong in tragopans, argus and peacock pheasants. Species that we have never had may be found there—largely, I suspect, because European amateurs are more active in collecting, and often band together to send out expeditions.

Much has been published in newspapers and magazines about the new zoo at Vincennes, outside of Paris, and I think there can be little doubt that it is the finest existing installation of its kind. Two theories seem to prevail as to types of zoological collections. One type is aimed at making an effective, spectacular exhibit; the other at the presentation of a zoological series. Generally speaking, Vincennes represents the first type marvelously well, and the New York Zoological Park and similar installations are examples of the other.

Vincennes zoo is a "made" zoo, completely. It is largely rock work and concrete, built on the

(Upper, left) The residence of M. Jean Delacour at Clères, where he maintains a great private collection of birds and animals. (Right) Black-necked swans and goslings.

(Lower, left) A section of the pheasant aviaries at Clères. (Right) Part of a large flock of white rheas on the bank of a stream, where they have almost complete liberty.



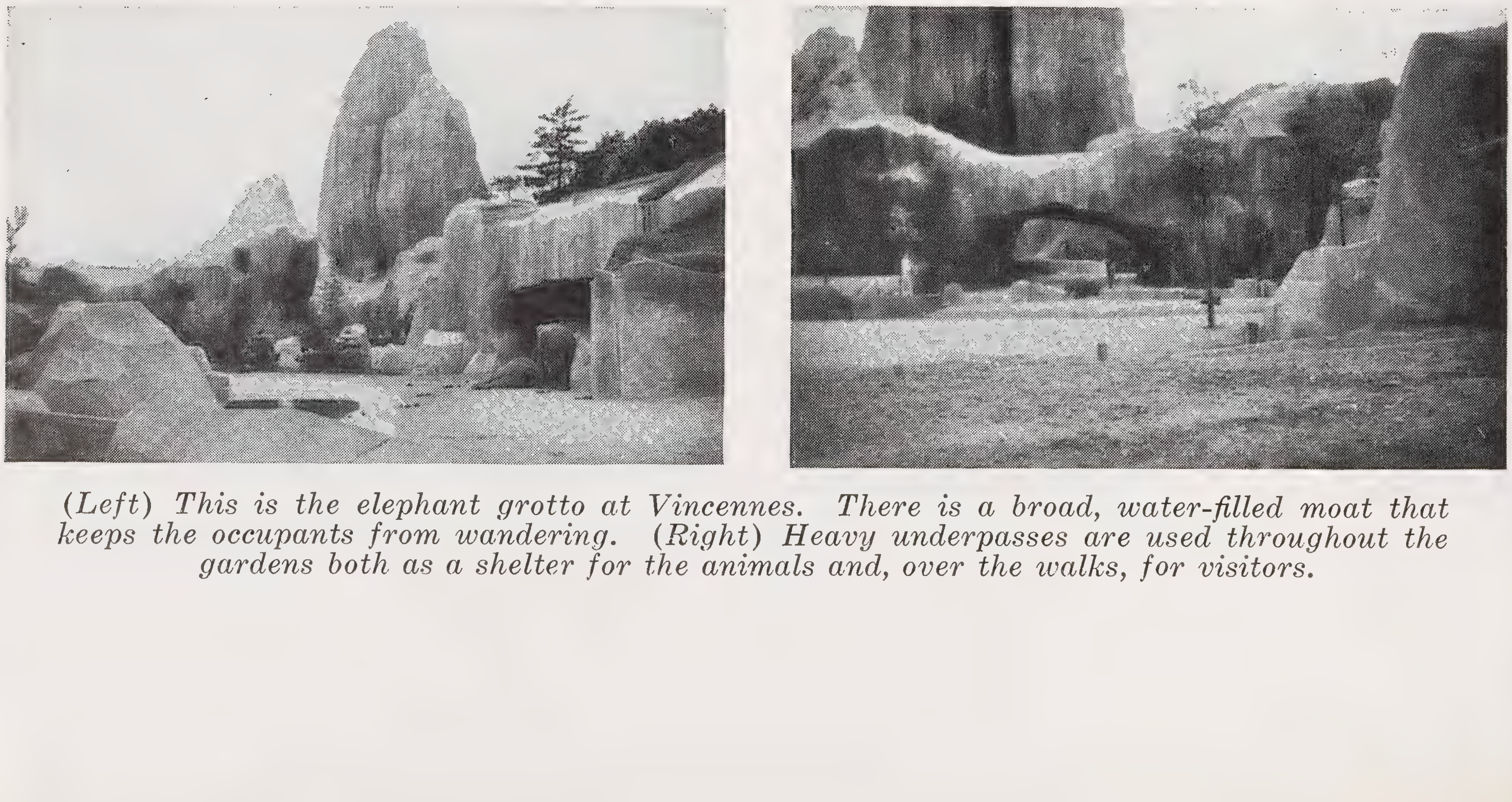
The monkey enclosure at the zoological gardens at Vincennes. Note the overhanging rock that affords a shelter from rain. A deep moat divides the enclosure from the walk where visitors pass.

moat plan without fences, and in the most modern manner. The large new concrete structures naturally look new, but when they have softened a bit the effect is bound to be very pleasing. What makes it effective is the fact that the entire installation is a unit; there is no jumble of old-type buildings in the conventional manner, with here and there a modern concrete-and-rock mountain. The whole thing is concrete-and-rock, and so cleverly done that the eye is not wearied by it. The impression, rather, is of wandering through some wild, serried badlands.

That style of exhibition means, of course, that when one has a monkey island—to take one example—all one's monkeys of whatever species must be exhibited on the monkey island. And that limits not only the number of specimens that can be exhibited, but particularly the kinds.

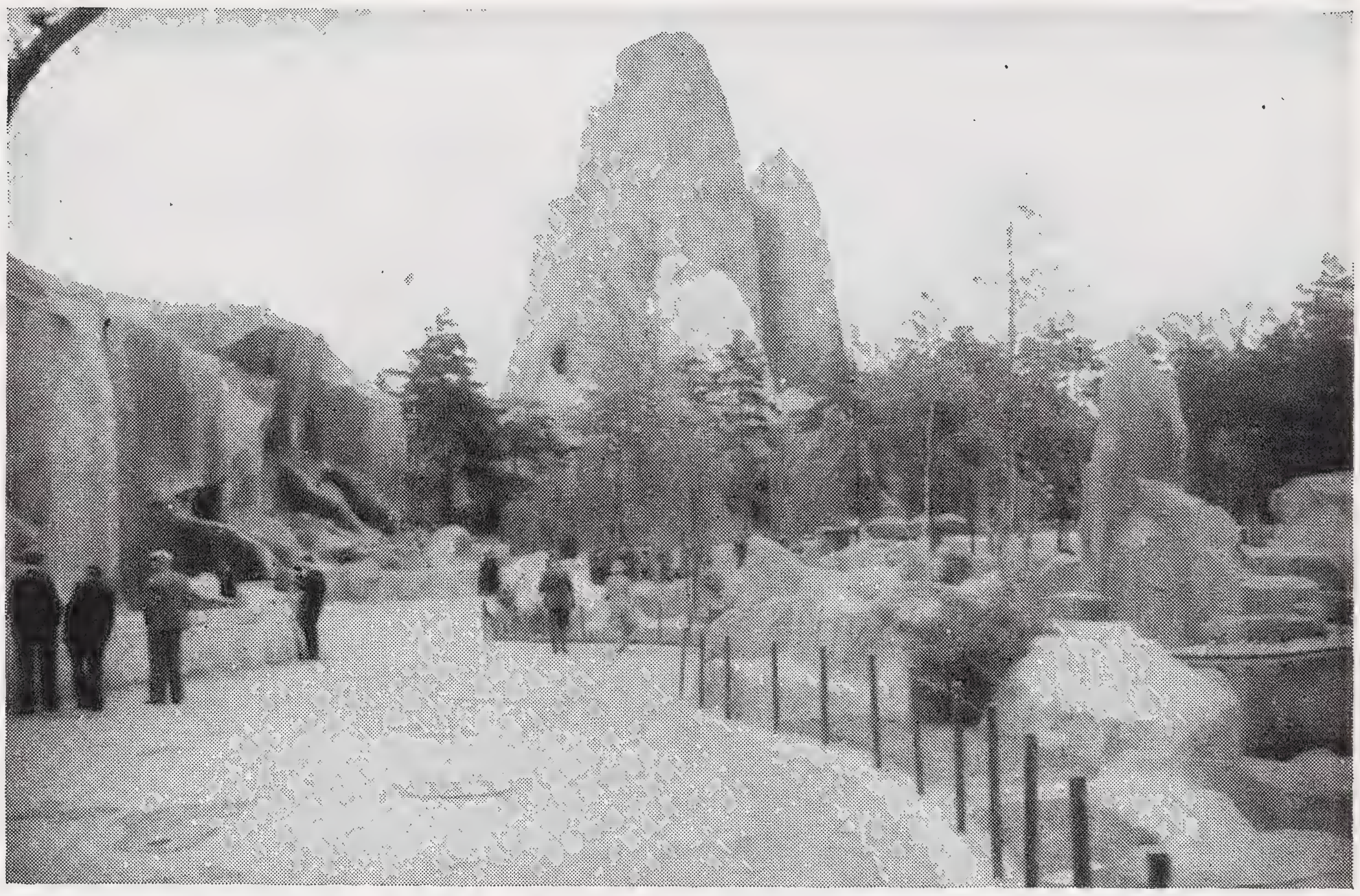
It was noticeable that all the "mountains" and ranges were deeply and widely moated—more extensively it sometimes seemed than was absolutely necessary. But none of the Vincennes collection will get out; there is a good margin of safety.

Instead of going to the Camargue with some other members of the Congress, I elected to pay a visit to the zoological gardens of Antwerp, Amsterdam and Rotterdam before going on to London. I was interested to discover that Antwerp still has the finest collection of eagles, owls and hawks in Europe—a feature for which the zoo has long been famous. Its old tower that used to house those birds has been torn down, and a new concrete structure is taking its place. Through long years Antwerp has proved a very important point in the successful keeping



(Left) This is the elephant grotto at Vincennes. There is a broad, water-filled moat that keeps the occupants from wandering. (Right) Heavy underpasses are used throughout the gardens both as a shelter for the animals and, over the walks, for visitors.

The pinnacle in the center of the Vincennes zoological garden dominates the whole installation. There is an elevator in the concrete peak, and from the top one may see Paris in the distance.

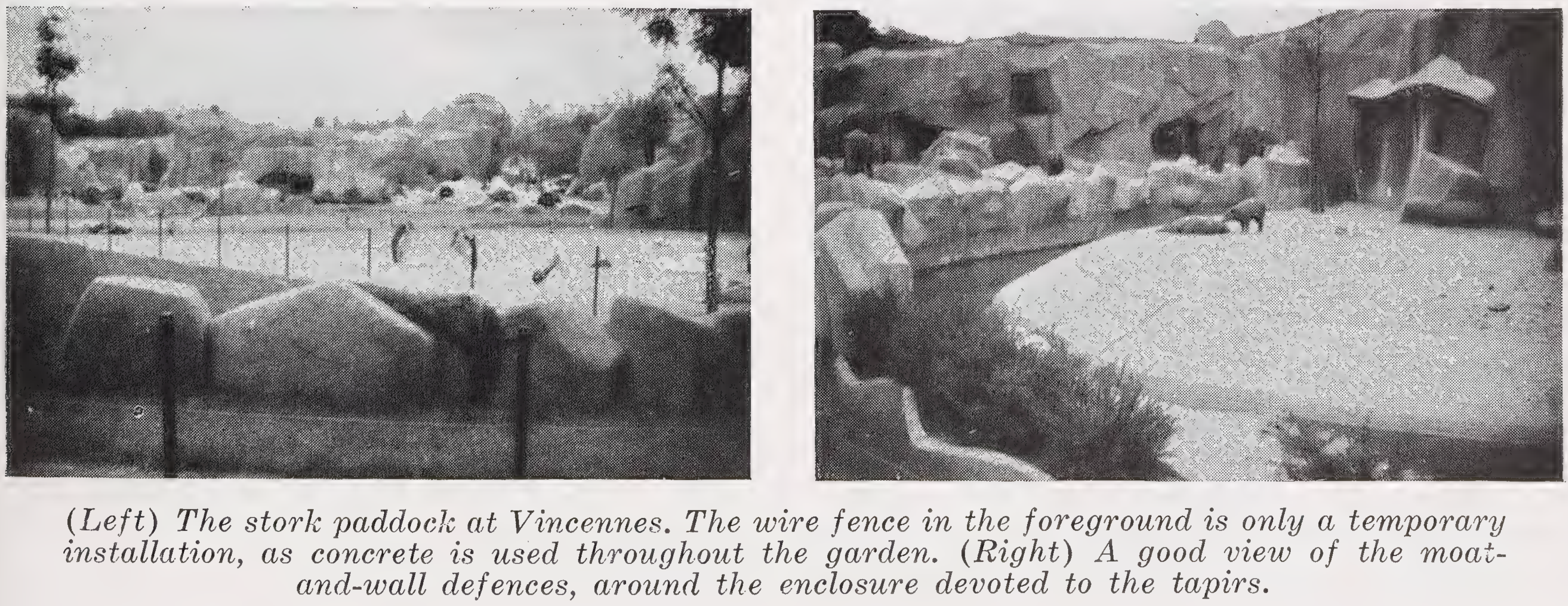


of such birds: they do not require the large flight space that is generally insisted upon in this country, but instead want roomy shelters where they can find protection from the weather. We, and most zoological parks in this country, would gain in the health and longevity and comfort of our raptorial birds if we were less swayed by the sentimental belief that such birds want plenty of flight space, and gave them more adequate shelters.

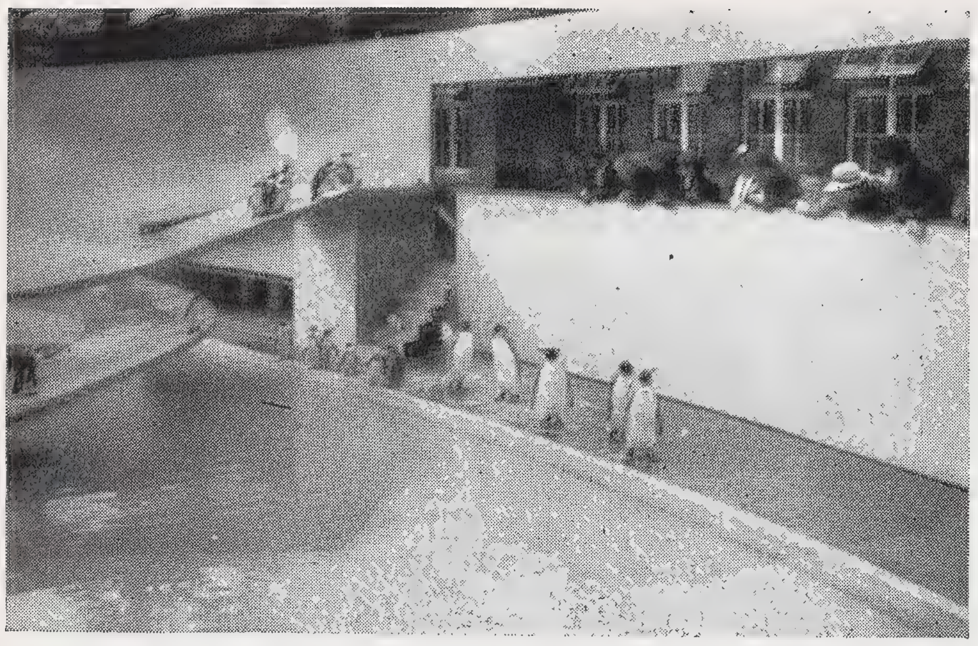
Rotterdam offered one most unusual sight—a pair of adult black jaguars living together. No one seemed to be able to explain how that example of domesticity among such jealous, bad-tempered carnivores came about. My guess is that they were reared together from cubhood.

Amsterdam zoo remains, as it has long been, one of the very fine zoos of Europe. Its wild cattle collection is particularly fine, and I was attracted by its fine series of storks, herons and cranes. It has a gorilla, now about four years old, and one of the largest orangs I ever saw—a specimen that has been in the collection for twelve years, having been received as a baby. A Komodo monitor has been in the zoo for seven years. I was informed that it is fed chiefly on live food—chickens and pigeons, with occasionally chopped meat. Milk and eggs, which we included in the diet of specimens exhibited here, are not fed to Amsterdam's monitor.

When we finally left the Continent for London, it was with the feeling that the collections I had seen have advanced considerably in the years since I saw them last, but that no great, outstanding experiments had been undertaken in methods of exhibiting animals.



(Left) The stork paddock at Vincennes. The wire fence in the foreground is only a temporary installation, as concrete is used throughout the garden. (Right) A good view of the moat-and-wall defences, around the enclosure devoted to the tapirs.



A section of the famous penguin pool in the London garden. Five species are shown.

At the request of Mr. David Seth-Smith, the Curator of Birds and Mammals in the London Zoological Gardens, I exhibited our slides of the displays of the birds of paradise at a scientific meeting of the London Zoological Society. Again our pictures were received with great interest, for London, like ourselves, has for years maintained a fine series of these magnificent birds. At the present time London is exhibiting twelve species or subspecies as against our fifteen.

Open planting has been used effectively in London. Parrot House in background.

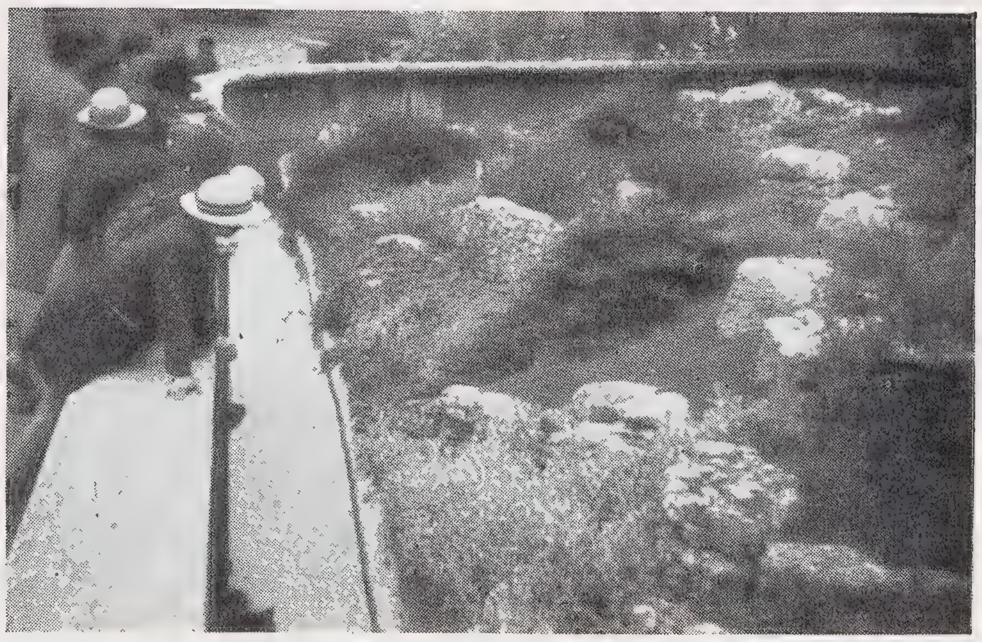
Among those twelve are a lovely male blue bird of paradise which we do not have now, and two species which are unique in collections—the orange wattled, and the Augusta Victoria.

London's new bird house is their old reptile house remodelled. While it does not seem to me entirely adequate, it nevertheless presents some valuable ideas. A feature I liked very much was a big octagonal cage in the center of the building, 30 by 20 by 15 feet. The back is enclosed in clouded glass, the sides in clear glass, and the front is a wire screen in the center of which is a small, darkened booth. A curved glass window, of the "invisible window" type, gives a view from the interior of the booth into the cage. Standing in the booth one has the impression of being actually in the cage among the birds.

Excellent as this idea is, I do not see how we could adapt it to our conditions. London Zoological Gardens get a steady crowd of visitors, rarely with peak days when scores of thousands of visitors are present. Such an exhibit in our Bird House would completely block traffic on a busy Sunday.

Newly opened transverse walks in the London zoo, used as paths for riding animals.

Another plan, and one that is more practicable for us, is the use of planting and a water spray. Heavy rockwork forms the background of the cage, and the interstices are stuffed with small plants and peat moss. The rockwork slopes down to a floor of coarse gravel. Periodically a light spray showers the whole interior. The



An excellent example of a Snake Pit, beautifully planted with flowers, in London zoo.

birds love it. All of them are of the tree type—sunbirds, tanagers, perching birds generally—and after dashing through the spray they must feel as if they had been through a gentle tropical rain. The spray washes off the plants, soaks into the peat moss, and the surplus runs off through the gravel. Thus, while the interior of the cage is kept humid, there is no excessive dampness.

Three sides of London's bird house are occupied by large cages, very much the proportions of our own. But the fourth side is occupied by two tiers of quite small cages, about two feet long, and in these are exhibited many small, delicate birds that it is almost impossible to keep in mixed cages. Everyone agrees that this is the only way to maintain such collections, and the proof lies in the fact that London has on exhibit an amethyst starling that has been there for seventeen years.

I was interested, too, to see London's technique in keeping hummingbirds, having heard that numbers of them were turned loose in one large cage. Nobody else had been able to do that, because of their quarrelsome disposition. London, I found, does have one large cage for hummers, but so thickly planted, with small clearings for each bird, that to all intents and purposes each one is confined to a small space of its own. This plan works quite successfully.

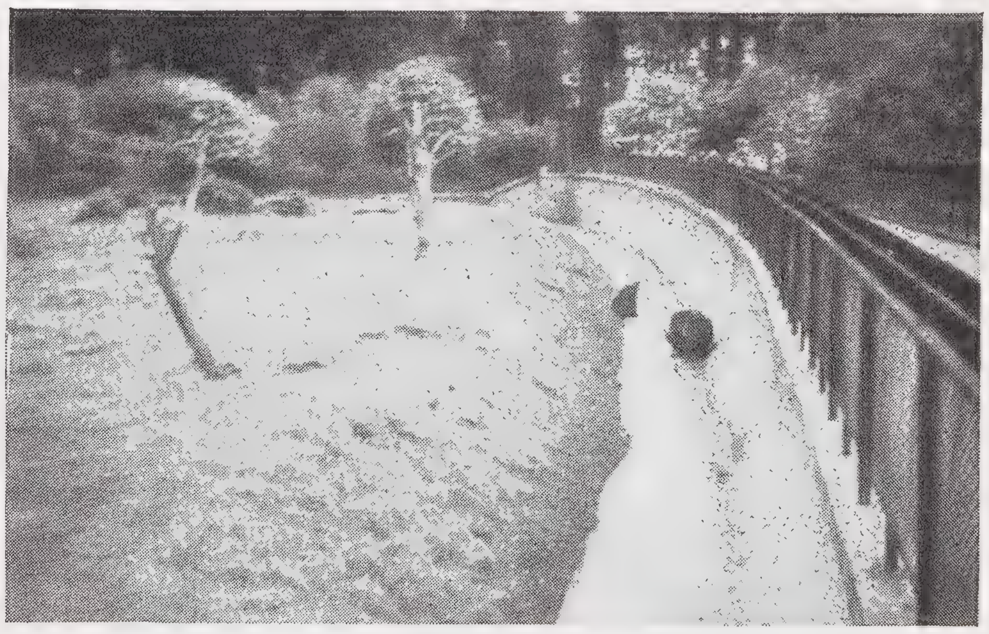
Several members of the London staff mentioned to me that they had heard our okapi—received last August at the same time as their own—had recently died. I was able to reassure them. Their own okapi, and a female bongo, are apparently in splendid health.

London has had considerable success in breeding chimpanzees, and two youngsters born late in 1937 are on exhibition four hours a day, two hours in the morning and two in the afternoon. They appear only behind glass.

For fear this article will occupy the entire *Bulletin* I shall have to report only briefly on Whipsnade, the country branch of the London Zoological Gardens. The prevalence of hoof and mouth disease in Europe has dictated precautions against its transmission by visitors, and on entering the area one wades through a bichloride solution. Even the tires of automobiles are bathed in the disinfectant. To date the disease has not appeared in the collection.

With 500 to 600 acres available, Whipsnade can indulge itself in very large ranges—so large, in fact, that it is sometimes difficult to see the animals. A new range for American bison has just been constructed.

To return, in conclusion, to Regent's Park, I find notes on two features that our Society might keep in mind. London Zoological Gardens have an especial appeal to children because of the number and variety of riding animals available—camels, ponies, elephants and llamas, the latter drawing small carts. And artists are able to make effective use of the London zoo because a studio has been built for them. Whole classes, as well as individual artists, are constantly at work there. A similar plan of cooperation between the art schools of New York and the Zoological Park might well be worked out here.



(Left) The chimpanzee island at Whipsnade. A heated underground hut provides shelter during the winter. (Right) The bear enclosure at Whipsnade. Unfortunately, the bears spend most of their time in the moat begging food from the visitors!

American Black Bass in South Africa

Large-mouth Species Has Been Successfully Introduced in Some Fifty Drainage Areas; Small-mouth Is Next

C. H. Townsend

THE Aquarium library recently received a report from the Fisheries and Marine Division, Union of South Africa, setting forth in detail the progress of its work in the Cape Province. It is a document of more than 100 pages dealing chiefly with the distribution of large-mouth black bass which have now been placed in approximately fifty distinct drainage areas. There was an earlier report, which, however, is not at hand.

In the present report it is stated that 45 large-mouth black bass bred in Holland in 1927 were placed in the government hatchery at Jonkershoek in 1928. These imported bass spawned for the first time in the South African spring months of October and November of 1929. A small number of the young bred in Africa were distributed to other waters. Young black bass from Jonkershoek were distributed during 1930, 1931, 1932 and 1933.

The amount of public interest shown in the black bass could be gauged by the large number of letters requesting information regarding them and which led to the preparation of this detailed report. These bass have been placed in various water areas from near sea level to an elevation of about 6,000 feet. Favorable reports as to their growth and propagation were made by sportsmen and government officials. Losses during transportation seem to have been negligible and the distributions now being made are from African-bred stock. Many of the bass were held at government hatcheries for observation and a good deal of biological study has been devoted to the condition and growth of the young. Anglers have made catches in some localities, the fish foraging on native fishes and small invertebrates. When it appeared that the food supply in some places might not be sufficient, the European tench was introduced. The appearance of a number of small tench caught in 1935 denoted that the introduced tench had spawned in 1934.

A bass which had been bred at Jonkershoek in 1930 and turned into a lake as a small yearling was caught in 1935. It weighed four pounds and was eighteen inches long. By the summer of 1934-1935 breeding by black bass had been definitely proved in 21 waters which had been stocked. There are now indications that bass which have grown to ten or eleven inches in one year may spawn under favorable conditions as yearlings. This has occurred with yearling bass of known age at Elgin and Graaff-Reinet. None of the small hatchery-bred bass which have been distributed have been known to spawn until they were two years old. In the majority of cases spawning occurs between the middle of October and the end of November. Nesting has been known to occur in September and shoals of fry are visible early in October. Large-mouth black bass may grow as large in South Africa as they do in our own Gulf states.

It is now proposed to introduce the small-mouth black bass. Our own fish-cultural operations with both species of black bass have shown their remarkable adaptability to cultural operations. The distribution of native American fishes to new regions has been successful in numerous instances. Perhaps the most notable transplantations were the Atlantic shad and striped bass to Pacific coast waters where both are now probably more abundant than on the Atlantic coast. Many years ago the writer captured shad as far north as the Stickeen River in Alaska, and for many years striped bass of large size have been taken in the San Francisco bay region.

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Notes from the Zoological Park and the Aquarium

Bird on the Windowsill

Curator Crandall is used to people telephoning him to ask what they shall do about strange birds on their windowsills. Sometimes they really are strange birds—pheasants, parrots, owls, wild ducks—but the strangest was a bird that was described over the telephone on July 11.

A man telephoned from one of the skyscrapers in the financial district and described "a large, reddish bird, with yellow plumes" that was perched outside his window.

"Why, that sounds like a bird of paradise!" Mr. Crandall exclaimed.

The man at the other end of the wire admitted that he had thought the same thing, having seen the birds of paradise in the Zoological Park, but he couldn't conceive of a bird of paradise being loose in the Wall street district.

Mr. Crandall remembered that the Paramount Aquarium, an animal importing firm with offices in downtown New York, had had a male Lesser Bird of Paradise. He suggested that the Wall street man call F. F. Cochu, the owner of Paramount Aquarium.

Half an hour later while Mr. Crandall was out of his office, Headkeeper Stacey received a phone call from Miss Janet Jean McCarthy, secretary to a lawyer on the thirty-sixth floor of an office building at 15 Broad street. The bird had flown in her window, and she had closed the window.

Not knowing that it was Paramount Aquarium's bird, and not getting a clear description of it, Mr. Stacey told the young woman to call the S.P.C.A. Later he mentioned the incident to Mr. Crandall, who immediately telephoned Paramount Aquarium and told Mr. Cochu where his bird could be found. It was caught without much difficulty a few minutes later.

The bird had escaped from its cage in the stockroom of the animal dealer on Sunday.

Recent Aquarium Accessions

Through the kindness of Mr. Thomas H. Dorr of the United States Bureau of Fisheries at Booth Bay Harbor, Maine, the Aquarium acquired four harbor seals late in June. Although not so active as the sea lions in the nearby pool, Pick, Pat, Amos and Angus, as they have been dubbed, attract fully their share of visitors with their appealing puppy-like visages and their deliberate, sometimes droll, actions.

A series of fish from Madeira has been received through the exchange arrangement with the London Aquarium. Included were scorpion fish, parrot-wrasse, swallow-tailed wrasse and striped sea perch. In one shipment were eight castanet fish, *Glyphisodon luridus*, sent over as food for two scorpion fish. As they had never been exhibited at the Aquarium it was hoped that at least one or two castanets would survive the voyage, but the scorpions' appetites were not to be denied and all eight ended up inside their hungry tankmates. The London Aquarium, however, generously sent seven more to New York in the next shipment. These close relatives of our West Indian beau-gregory are dark in general hue, but take on a decided golden color when viewed in a certain light. Outstanding are the spots of violet on their heads, bodies and fins. This color is so intensely bright that it seems to be luminescent.

Six four-eyed fish were obtained from Para, Brazil, on July 12. These featured a shipment of South American fresh water fish, others of which were also purchased. One of the four-eyed fish is almost twice as large as any previously exhibited.—J. W. A.

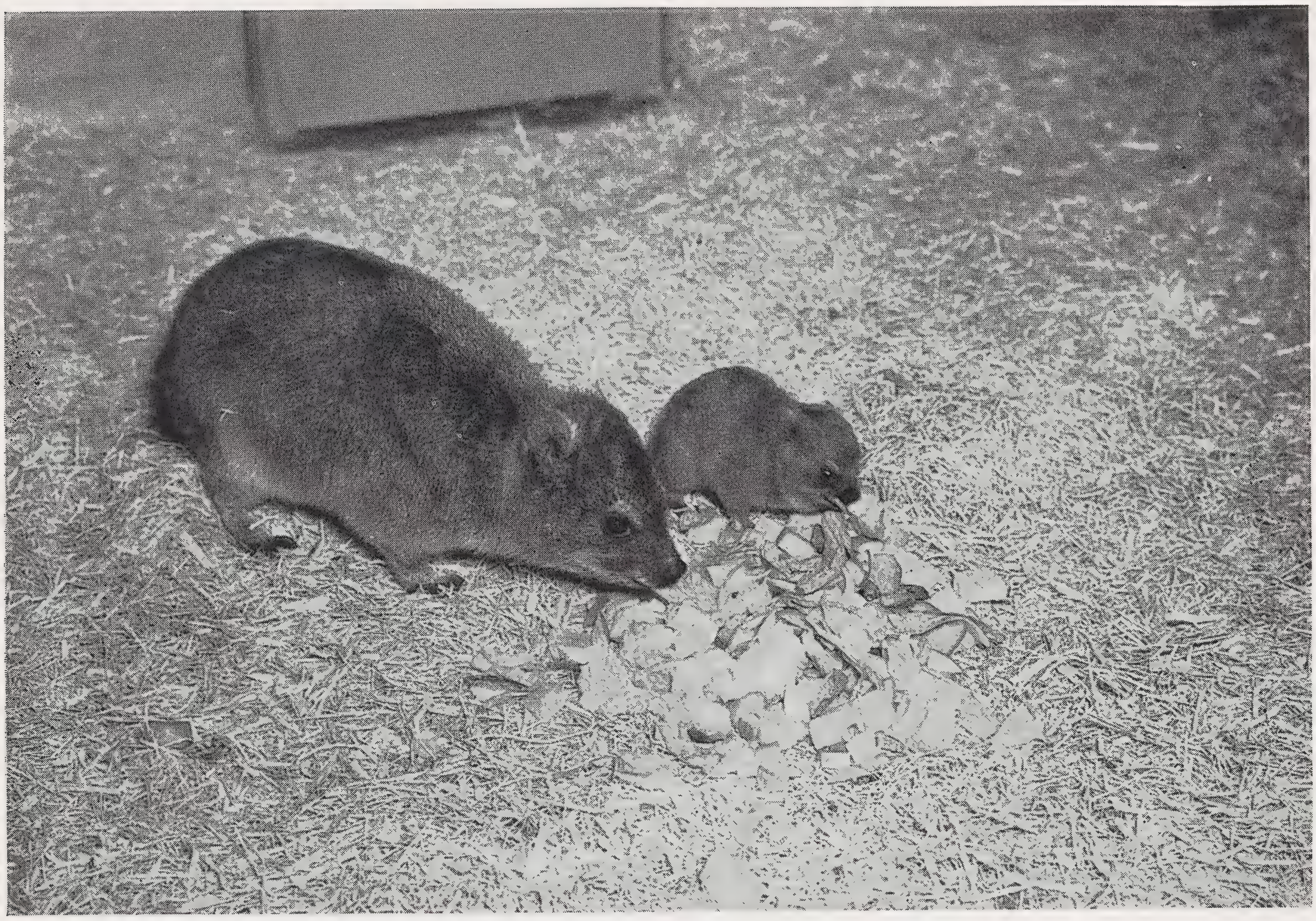
Birds and Beetles

The prevalence of Japanese beetles in the New York City area has made the public highly conscious of the harm they do and the necessity of controlling them. It was probably with some idea of calling attention to a new enemy of the beetles that a man in late July brought into Curator Crandall's office the stomach of an English sparrow—crammed with iridescent fragments of Japanese beetles.

He explained that he had seen the bird killed by an automobile, and out of curiosity had picked up the body and removed the stomach for examination. Finding the beetles in it, he thought that he had made a discovery of economic importance.

At a matter of fact, the liking of sparrows and a good many other birds for Japanese beetles has been known for several years. Dr. Claude W. Leister of the Zoological Park's staff demonstrated the relations between birds and Japanese beetles in 1921 when he made the first bird-beetle survey for the Bureau of Biological Survey.

The insects had been discovered a short time before at Riverton, New Jersey, and it was in that area that Dr. Leister was sent to examine the stomachs of local birds to determine if any of them were serious enemies of the invaders and could be counted on to help control them. He discovered that English sparrows, purple grackles, starlings, cardinals, crested flycatchers, rose-



The youngest animal in the Small Mammal House is a baby hyrax, born early in June. The hyrax is not very common in captivity, and the baby is of special interest since it is probably the first to be born in this country. The baby is a small replica of its mother.

breasted grosbeaks, red-wing blackbirds, and a few others habitually ate Japanese beetles. His findings for that limited area looked so promising that later a wider and more exhaustive research into the matter was undertaken by the Biological Survey.

Chinese Muntjacs

A pair of Chinese muntjacs (*Muntiacus reevesi*), were placed on exhibition in the Small Deer House early in July.

We now have two species of these little deer which are likewise called barking deer and rib-faced deer. The typical muntjac (*Muntiacus muntjac*), from the Indo-Malayan region, has been exhibited on several former occasions, but the present specimens of the eastern Chinese species are the first to be received.

Muntjacs are primitive deer and have preserved for the present day several characteristics of species long extinct. The short, unbranched antlers are supported by long, skin-covered pedicles, the latter continuing downward across the forehead as prominent ridges, thus giving rise to the name rib-faced deer. The male possesses two long tusks in the upper jaw. These, and the antlers, are lacking in the females.

Muntjacs are now confined to southeastern Asia and the Malay region, but a number of American cervines in the Miocene and Pliocene, and of course now long extinct, possessed the elongate pedicles and small antlers of the muntjacs to an exaggerated degree. Several of these species had three antlers.—C.W.L.

Good Omen

Being an optimist who sheds,
On Sunday afternoons, his trammels,
Who hobnobs with such quadrupeds
As bison, zebras, yaks and camels,

I can dispense with unicorns,
With antic fauns and centaurs rearing,
Glad of the usual hoofs and horns,
Finding the prospect rather cheering.

When politics begin to pall
And new recessions haunt one's pillow,
It's really restful, after all,
To contemplate the armadillo.

Let prophets cry calamity,
The country fume with propaganda—
Up in Bronx Park I can go and see
A Giant Panda!

—*Leslie Nelson Jennings in the*
New York Herald-Tribune.

"Where is that keeper? Where is our dinner?" is the title Miss Wright gave to this photograph of the lion cubs which she snapped during the afternoon of the spring Animal Party on May 26. The cubs were born a year ago in the Park, and are rapidly growing out of their cubhood.

Animal Party Picture

The drizzling rain that fell all through the afternoon of the Zoological Park's Animal Party on May 26 created hazards that few of the many guests who brought cameras were able to overcome. However, Miss Alice I. Wright of Briarcliff Manor, a Member of the Society for several years, did manage to take one picture in the Lion House which she submitted in the Animal Party's camera contest. It is reproduced herewith. Miss Wright's own comment was that she felt it was not so much a photographic achievement as a lucky shot. Her exposure was one-fourth of a second.

Next year, given good weather, we hope that special facilities can be created for camera enthusiasts and that many good pictures will result.

* * *

J. E. Ward, the author of "Curious Australian Bee-eaters," is an Australian naturalist with more than fifty years' experience with the wild life "down under." He was born in England but went to Australia as a child. Aviculture has at times been his profession, and always his hobby. In 1928 when Curator Crandall went to New Guinea to collect birds of paradise, "Pop" Ward was his guide and associate in the field work. Mr. Crandall describes him as "the best hand with newly-caught birds" that he has ever known.

World-wide Conservation

Early in the present year the offices of the American Committee for International Wild Life Protection were removed from Cambridge, Massachusetts, to the New York Zoological Park. Although the members of the Zoological Society have been informed from time to time, through the *Annual Report* and at the annual meetings, of the part their representatives have taken in the affairs of the American Committee, the recent developments would seem to offer an opportunity for presenting a brief history of the Committee and an account of its work.

Coinciding with the change of headquarters, Mr. Childs Frick of the American Museum of Natural History was appointed chairman and Dr. W. Reid Blair executive secretary, succeeding Dr. John C. Phillips and Mr. Harold J. Coolidge, Jr., respectively.

The American Committee is eight years old. Even the idea of wide international cooperation to save wild life from commercial hunters, misguided sportsmen, savage tribes and the avoidable impacts of civilization is only twenty-five years old. It was only in 1913 that the first international conference on nature protection was held, in Switzerland, with seventeen countries represented. It worked out some wise plans, but the World War nullified them.

International conservationists began to stir again after the war. Dr. P. G. van Tienhoven of Holland and Dr. J. M. Derscheid of Belgium were particularly active, and international committees and societies were formed in England, France, Belgium and Holland. Some of them attacked specific problems and others, like the International Office of Documentation and Correlation for the Protection of Nature, in Brussels, of which Dr. Tordis Graim is secretary, now have the backing of several governments. The Brussels office is the most extensive source of information on threatened exotic species of mammals over the whole world. It has been functioning since 1928 as a sort of clearing house on wild life protection.

Generally speaking, the United States has made an excellent record in meeting conservation problems within its own borders. Europeans have looked with considerable envy at our national parks, sanctuaries and game preserves. It was felt that morally and practically this country could help the cause.

It was at a meeting in January, 1930, of the Boone and Crockett Club—the same club whence stemmed the New York Zoological Society more than forty years ago—that American sympathies with the international conservation movement took a practical turn. Dr. Phillips and Mr. Coolidge drew up a motion that the club appoint a committee to handle all affairs dealing with international wild life protection.

The late Madison Grant presided at that meeting, and his committee was so formed that it

The so-called "bird-eating spider" on exhibition in the Reptile House probably makes a practice of eating insects, small lizards and small rodents more often than birds. However, it looks fearsome enough to overcome a nestling. It has a leg-spread of about 5 inches.

represented not only the Boone and Crockett Club, but a few other institutions interested in international conservation. Dr. Phillips was made chairman and the other members were Mr. Kermit Roosevelt for the New York Zoological Society, Mr. George Pratt for the American Museum of Natural History and Mr. Coolidge, secretary, for the Boone and Crockett Club. These four original members were asked to select other representatives from other institutions all over the country.

As a brochure on the first five years of the American Committee put it:

"The American committee, it was decided, should be made up of influential men from the leading natural history museums, zoological societies, and conservation organizations in the country, because of all our people who had first-hand knowledge of wild life problems throughout the world, the members of such organizations were best qualified. The various scientific expeditions of our museums, the large collections and special libraries, and their many members who travel widely, contribute greatly to our knowledge of exotic mammals and birds. Finally, in the last analysis, choice depended on the sound judgment in such matters which could be expected from men with a scientific background as well as active field experience."

The way the organization was finally worked out, there was to be a small executive committee and a larger advisory board. The executive committee now has six members:

Childs Frick, *chairman*
W. Reid Blair, *secretary*
Harold J. Coolidge, Jr.
John C. Phillips
Warren Kinney
Laurance S. Rockefeller

Being small, the executive committee can meet as often as necessary. The larger advisory board of twenty members is called together once a year, and in the interim is consulted by correspondence. The advisors cooperate with the executive office and strengthen its work by writing special letters on behalf of their institutions in particular emergencies. The advisors are:

Thomas Barbour, for the Museum of Comparative Zoology.

Frederick R. Burnham, for the California Academy of Sciences.

Charles M. B. Cadwalader, for the Academy of Natural Sciences of Philadelphia.

James L. Clark, for the Camp Fire Club of America.

Harold J. Coolidge, Jr., for the American Society of Mammalogists.

W. Redmond Cross, for the New York Zoological Society.

Stanley Field, for the Field Museum of Natural History.

Frank B. Foster, for the Philadelphia Zoological Society.

Childs Frick, for the American Museum of Natural History.

Joseph Grinnell, for the Museum of Vertebrate Zoology, University of California.

William P. Harris, Jr., for the Museum of Zoology, University of Michigan.

Edward House, for the Carnegie Museum.

Edward Mallinckrodt, Jr., for the Washington University, St. Louis.

John T. McCutcheon, for the Chicago Zoological Society.

Robert T. Moore, for the California Institute of Technology.

John C. Phillips, for the American Wildlife Institute.

Kermit Roosevelt, for the National Association of Audubon Societies.

Dean Sage, Jr., for the Boone and Crockett Club.

Rodolphe M. de Schauensee, for the Wilderness Club.

Alexander Wetmore, for the Smithsonian Institution.

Transfer of the American Committee's offices from Cambridge to the New York Zoological Park will in no way affect the status or continuing policies of the Committee. Its work is financed through contributions from member organizations and individuals interested in world-wide conservation of wild life resources. A large part of the regular office work consists of the preparation of material for publication and maintaining correspondence with all countries in order to keep in touch with their conservation problems, legislation, conferences, and conventions.

To date the Committee has published the following brochures dealing with some special problem of wild life protection:

No. 1. Report on the available evidence showing the relation of game to the spread of the tsetse fly borne diseases in Africa. By Richard P. Strong, Joseph C. Bequaert and L. R. Cleveland. 1931.

No. 2. Range conditions in the wood buffalo park of western Canada with notes on the history of the wood bison. By Hugh M. Raup. 1933. (Edition exhausted).

No. 3. African game protection; an outline of the existing game reserves and national parks of Africa with notes on certain species of big game nearing extinction, or needing additional protection. Prepared by Elisabeth Hone. 1933. (Edition exhausted).

No. 4. Migratory bird protection in North America; the history of control by the United States Federal Government and a sketch of the treaty with Great Britain. By John C. Phillips. 1934. (Edition exhausted).

No. 5. The present status of the muskox, with notes on distribution, extirpation, attempts at domestication, protection, habits and life history. Prepared by Elisabeth Hone. 1934.

No. 6. The London Convention for the Protection of African Fauna and Flora (1933), with map and notes on existing African parks and reserves. 1935. (Edition exhausted).

No. 7. Notes on South African nature reserves; a report prepared for the American Committee for International Wild Life Protection by Thomas Barbour and Margaret D. Porter. 1935.

No. 8. Nature protection in the Netherlands Indies; a translation from Supplement to Contribution No. 10 of the Nederlandsche Commissie voor Internationale Natuurbescherming. 1936.

No. 9. Organisation of nature protection in the various countries. By G. A. Brouwer. A translation of the Dutch book "De Organisatie van de Natuurbescherming in de verschillende Landen." 1938.

These brochures are distributed without charge to organizations, libraries, schools, museums, government conservation departments and conservation-minded friends of the Committee in this country and more especially abroad. They are available to anyone else through the office in the Zoological Park, at very small cost.

Besides collecting valuable files on species already rare or threatened through over-hunting or over-civilization of their environment, the Committee has made special pleas for the chinchilla, the Spanish ibex, the various species of rhinoceros, the giant sable antelope, the Australian koala, gorillas, elephants, mountain nyala, mountain zebra, red hartebeest and certain species of whales.

PUBLICATIONS OF INTEREST

THE FIGHT TO LIVE. By Raymond L. Ditmars. 232 pages, 53 illustrations. Frederick A. Stokes Co., New York, 1938. $2.50.

The thesis of "The Fight to Live," that through the ages animals have developed specialized organs and abilities that enable them to compete more successfully, is one that does not have to be proved. It is self-evident. The interest in that theme lies in the examination of a wide variety of evidence, drawn from mammals, birds, reptiles and invertebrates, such as Dr. Ditmars has assembled here.

One after another, in apes and monkeys, carnivores, birds, snakes, amphibians, fishes, insects, the Zoological Park's Curator of Mammals and Reptiles traces the line of special development for offense or defense or protection by concealment. The devices that Nature has hit upon to insure the continuation of species are almost limitless. Teeth and claws, horns and antlers, spines and protective armor are familiar ones. The skill and instinct that enable certain birds to weave strong, pendant nests far out on the branches of jungle trees where predators cannot reach them are contributions to those species' chances of survival. So, too, are the form and color of the South American vine snake which at a glance can hardly be distinguished from a trailing vine itself.

Some turtles that can scarcely be induced to bite—such as the box turtle—are completely encased in armor. When the plastron is closed, they are virtually hermetically sealed. On the other hand, the snapping turtle has much of his fleshy part permanently exposed. Strong jaws and a readiness to bite viciously are *his* protection.

Examples could be multiplied almost indefinitely, and Dr. Ditmars does multiply them, through many chapters. Man himself has a place in the roll-call.

"In his short, dominating reign on earth [Man] has copied, consciously or unconsciously, a procession of useful and protective devices that have existed among wild creatures through the ages. From rough, cave-man tactics, he graduated from stone hatchets to studded war-clubs, on a parallel with the spiked, pounding tails of the ancient glyptodonts. He took to protective armor, which in nature had come into use millions of years before the dinosaurs. In making the hypodermic needle he duplicated the serpent's fangs. And, to cite several others out of many imitations, there is the modern adaptation of camouflage, a natural art going back millions of years; the use of electricity, which was utilized among fishes long before the advent of cave-men; smoke screens and poison gas—age-old defenses among primitive forms of the sea; the art of flight, which first appeared among the pterodactyls or aerial reptiles a hundred million years ago; the prowling under water by means of diving-bells and submarines; and devices for ultra-sensitivity to sound waves, which existed among primitive insects."

Man has found that about the time an inventor develops an armor-plate that positively cannot be pierced by any projectile, another inventor comes along with a projectile guaranteed to pierce any armor-plate. So it is in the animal world. The armadillo can roll into a tight, armor-protected ball—but jaguars and pumas with teeth and claws can pierce that defense. Skunks are snake-killers, and some skunks, the author says, have been shown to have high immunity against serpent poison. Some birds are able to kill poisonous snakes by carrying them into the air and dropping them from great heights. Thus it goes, defense and offense pitted against each other. The fight to live is never decisively won.

THE BOOK OF WILD PETS. By Clifford J. Moore. G. P. Putnam's Sons, New York. $5.

Here is a book which will be of great service to every teacher of natural history and to all others who are called upon to answer questions on the care of wild animal pets. Here is a generous amount of well-selected information, not only concerning the usual pets, be they mammals, birds, reptiles or amphibians, but in addition about the usually-forgotten invertebrate spiders, crustaceans and insects. We also find excellent material on the construction, stocking and maintenance of three kinds of terraria. All this is reinforced with more than three hundred illustrations. So complete is this book that it will surely prove to be an answer to many a nature study teacher's prayers.

Because of its size, "The Book of Wild Pets" appears to be rather formidable, but once the covers are spread we find the contents to be distinctly readable. Mr. Moore has the faculty of telling the "how to do" part of his story simply and effectively, bringing in just enough pertinent natural history and personal experience to make the entire account pleasant to take. The very size of the book indicates that a tremendous amount of work was necessary in order to locate, evaluate and adapt the material used. It is the most comprehensive work on the subject that this reviewer has ever seen.

In recent years we have noticed a rapidly growing interest in keeping insect pets and a considerable amount of information from the pioneers in this hobby is now available. This reviewer is glad to see two chapters in Mr. Moore's book devoted to insects and spiders, for he has long been interested in these animals and believes that certain species of each really make better pets than most fish and reptiles. However that may be, we can agree with Mr. Moore when he says that "The lives of many of them as they transform through various stages, afford more fascinating stories than are found in all fairy lore; many of them show exquisite colors and markings. And above all else, they are small and are, therefore, easily confined for observation."

While the "Book of Wild Pets" is exceptionally well illustrated, considering the large number of included cuts and diagrams, the photographic cuts in many instances lack distinctness, due to the reproducing process used. As a whole, however, the book is an excellent one. The arrangement of material (with the exception of one or two notations) seems to be logical, and the contents are well indexed.—C. W. L.

THE LONDON ZOO. By E. G. Boulenger. E. P. Dutton & Co., N. Y., $2.00.

This compact little volume is in effect a guide book to our sister institution in London. Mr. Boulenger, because of his many years of experience, is specially qualified to give this account of his charges and their fellows.

The appetites of zoo animals are always of some concern to the average visitor to the zoo, and particularly so to those persons who are interested in keeping various animal pets. The food demands of a large zoo are astonishing in their variety and sometimes quantity. As Mr. Boulenger infers, there are "several thousand epicures and gluttons" to be taken care of, and the list of food items and the quantity of each required in the course of a year is rather stupendous. In captivity it is, of course, usually impossible to give an animal the same food which it was accustomed to eat in the wild. Suitable substitutes must be found, but in some instances strange food items are specially imported.

A considerable amount of natural history and animal psychology is contained within the pages allotted to the exhibits at the zoo and their related groups. Much of this material is unique and the result of years of observation and association. It is not dry reading and while, as a whole, the book is of special interest to those who can and do visit the London Zoo, it likewise is of considerable worth to the general reader.—C. W. L.

CLEVELAND'S NATURE TRAILS. The Cleveland Press, Public Service Bureau, Omar Ranney, Editor.

Ten additional nature study sheets have been received from the *Cleveland Press*. They make a welcome addition to the fourteen studies incorporated in the original booklet reviewed in these columns some months ago (July-August, 1937).

The present studies take us from "And Now Comes Autumn" through "The Forest in Winter," and conclude with a list of spring migration dates for the common birds of the Cleveland area.

Here are forty-eight pages of good nature study material that can be had at a reasonable price. The complete booklet can be obtained from the *Cleveland Press* for fifteen cents. Those who already have the original publication can purchase the additional sheets for five cents. In spite of the more or less local character of this material, it is said to have circulated in twenty different states.—C. W. L.

"For a complete knowledge of our western history, this book is indispensable."

—PAUL ENGLE, *Cedar Rapids Gazette*

THE
AMERICAN
BISON
by
MARTIN S. GARRETSON
Secretary of the American Bison Society; Curator of the National Museum of Heads and Horns.

$2.50

● Reviewers have extended a uniformly cordial welcome to this history of the American Bison written by a member of the New York Zoological Society's staff, and published by the Zoological Society. It is magnificently illustrated by 65 halftones and linecuts.

"[Mr. Garretson's] book will have to be included in every man's library, or the library will be incomplete."—E. CARL SINK, *Winston-Salem Journal and Sentinel.*

PUBLICATION OFFICE ● NEW YORK ZOOLOGICAL PARK
185th Street & Southern Boulevard, New York, N. Y.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Forty volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XXII are complete and indexed. Volume XXIII will be issued during 1938, in quarterly parts. *Zoologica* is sent to members on request.

[*Zoopathologica,* Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica. Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report, Zoologica* and *Zoopathologica,* as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager, Zoological Park,* 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

Clark and Fritts, New York, Printers.

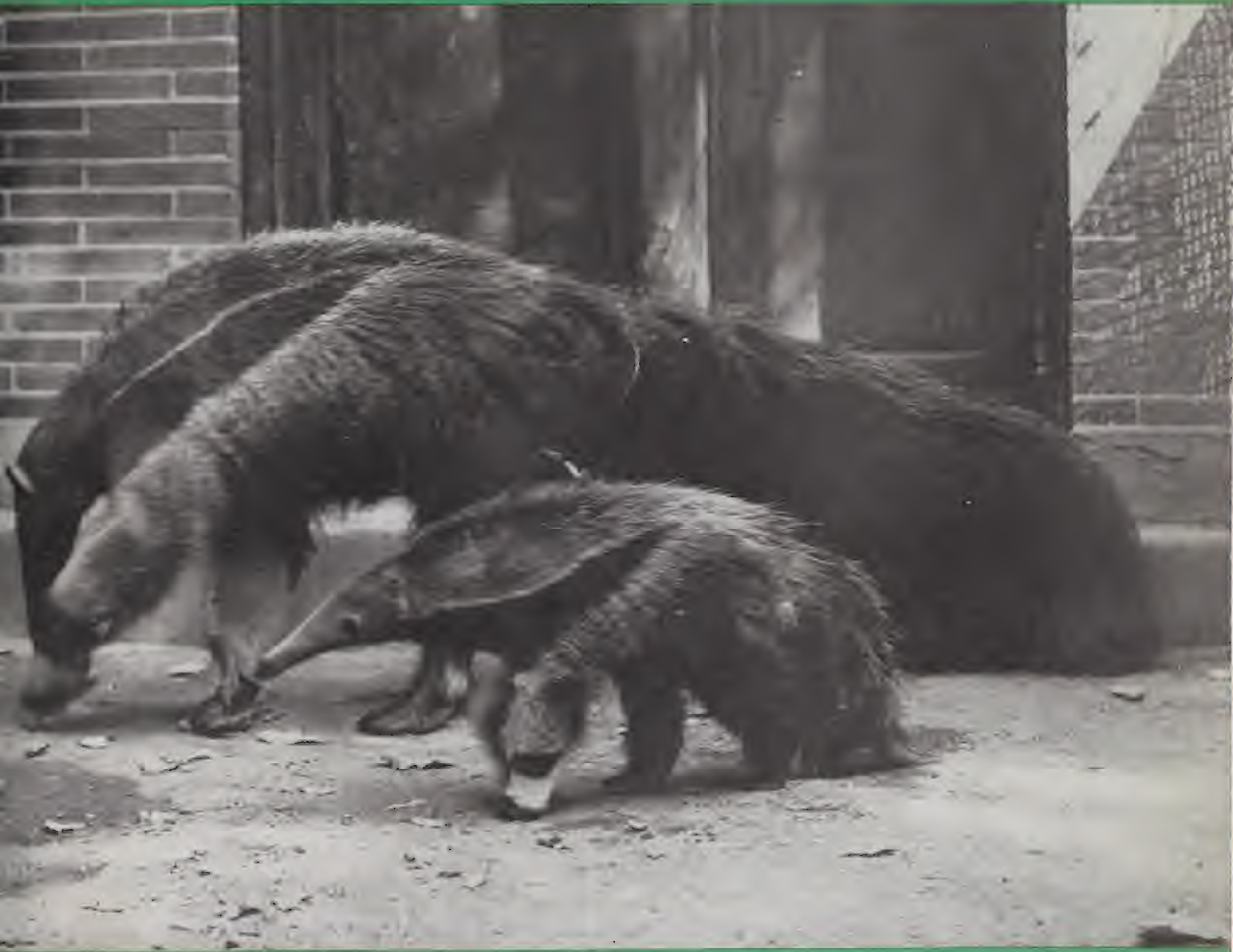
NEW YORK ZOOLOGICAL SOCIETY
FOUNDED 1895

l. XLI, No. 5 September-October, 1938

SMITHSONIAN INSTITUTION
OCT - 6 1938
NATIONAL MUSEUM

BULLETIN

NEW YORK ZOOLOGICAL SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

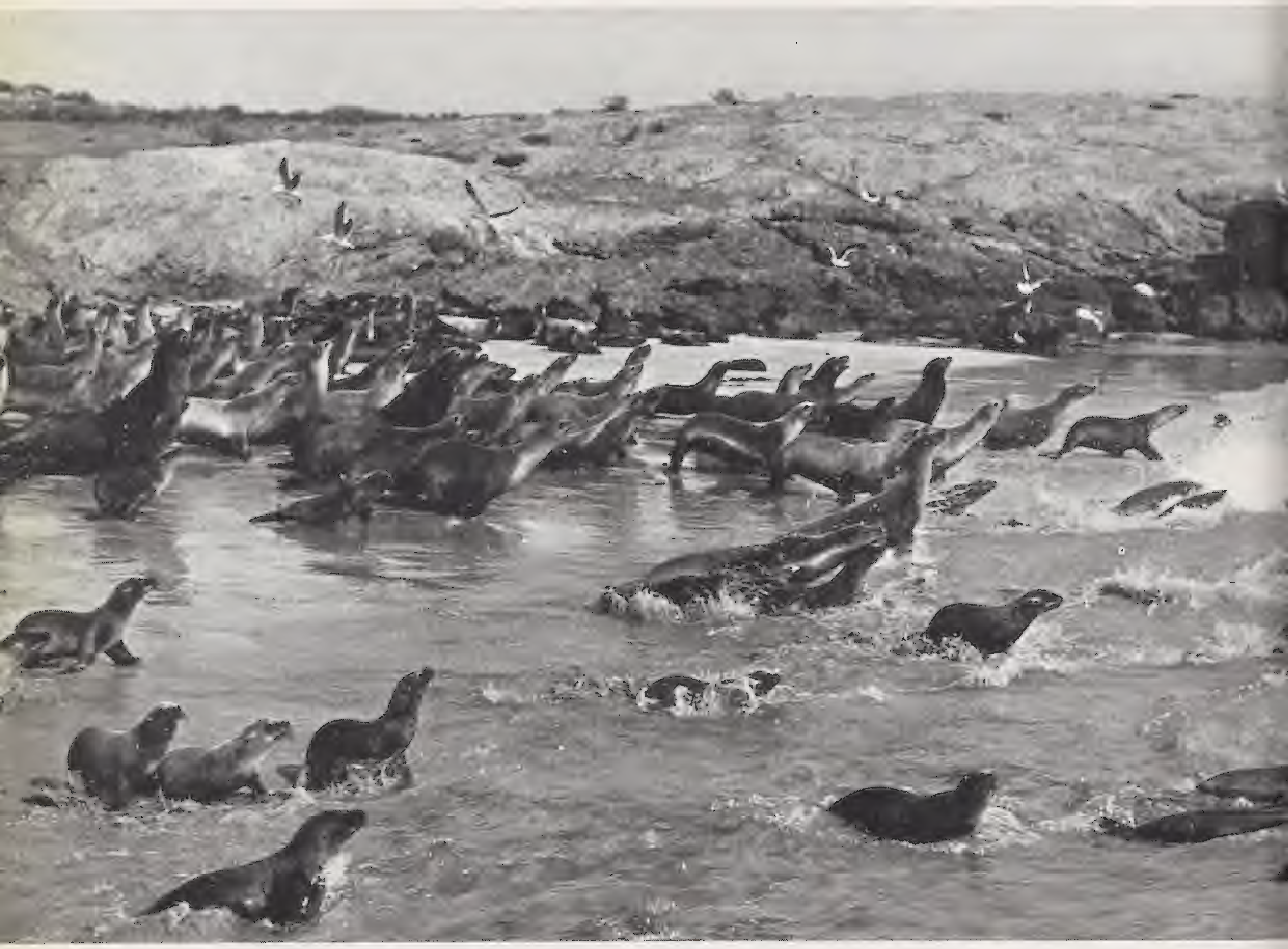
Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



Photograph by John Tee-V

The San Benito Islands are the home of hundreds of sea lions, which rushed toward us as we approached. The splashing water, outcries of the animals and screams of gulls made a sudden uproar amid the silence of these desert islands.

BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

Published by the New York Zoological Society

Vol. XLI September-October, 1938 No. 5

Forty Bays

Along the West Coast of Central America the Department of Tropical Research Again Has Dipped Its Nets

William Beebe

A VERY definite satisfaction attends the completion of any preconceived program of activity. Our zoological studies in the eastern Pacific, which began on the *Zaca* in 1936, extended as far south as Cape San Lucas and Mazatlan. On the most recent, the second *Zaca* expedition, these investigations were continued south as far as Panama.

There seems to be a very distinct faunal area which is bounded on the north by Cedros Island and by Panama on the south, and from November 6, 1937, to April 5, 1938, we traversed this section of the western coastline of North America.

For the second time Mr. Templeton Crocker generously placed his yacht at the disposal of the New York Zoological Society, resulting in the Twenty-sixth Expedition of the Department of Tropical Research.

Before we started, the west coast of Central America meant to us only an irregular extent of meeting place of land and sea. Now, it consists of forty-odd bays, with extremes on the north of sheer desert, grading southward into typical tropical rain forest; vertically we envisage it from the tops of the coastal hills and mountains to what our nets brought up from a half-mile depth in the Pacific Ocean.

Rarely we anchored off cities—Manzanillo, Acapulco, La Union, Corinto, Puntarenas—but in perspective these were only rare human intrusions into a region of wild beauty seldom visited and wholly unmarred by activities of mankind.

The closeness to the shore and the height of the Sierras — joining the Rockies with the Andes—introduced an unexpected element of isolation, and made this series of bays and their fringes of level land a chain of islands, a linear archipelago of sorts, with mountains and sea for boundaries. So shut off from the rest of the mainland were many of the bays that we hardly ever thought of any man-made limits—Mexico, Nicaragua, Costa Rica, Panama—all were merged in a long extended coast of beauty and interest. Neither the scattering of kindly natives with whom we made friends, nor land, shore or sea suggested republics or political divisions.

In all this we revelled, comfortably yachted as to bed, food and laboratory, and able to anchor close to the shore of tiny unexplored bays. Best of all, we were not hurried. If heavy surf and sheer mountains forbade profitable investigation, we left after a few hours of exploration in the launch; if on the other hand a narrow entrance led into an expanse of sheltered beaches, sand alternating with rocky tide-pools, and jungle creeping down to the very shore, we settled down for a ten-day visit. This enabled us to reduce collecting to a reasonable proportion of the time, and afforded hours and days for observation of the living creatures themselves.

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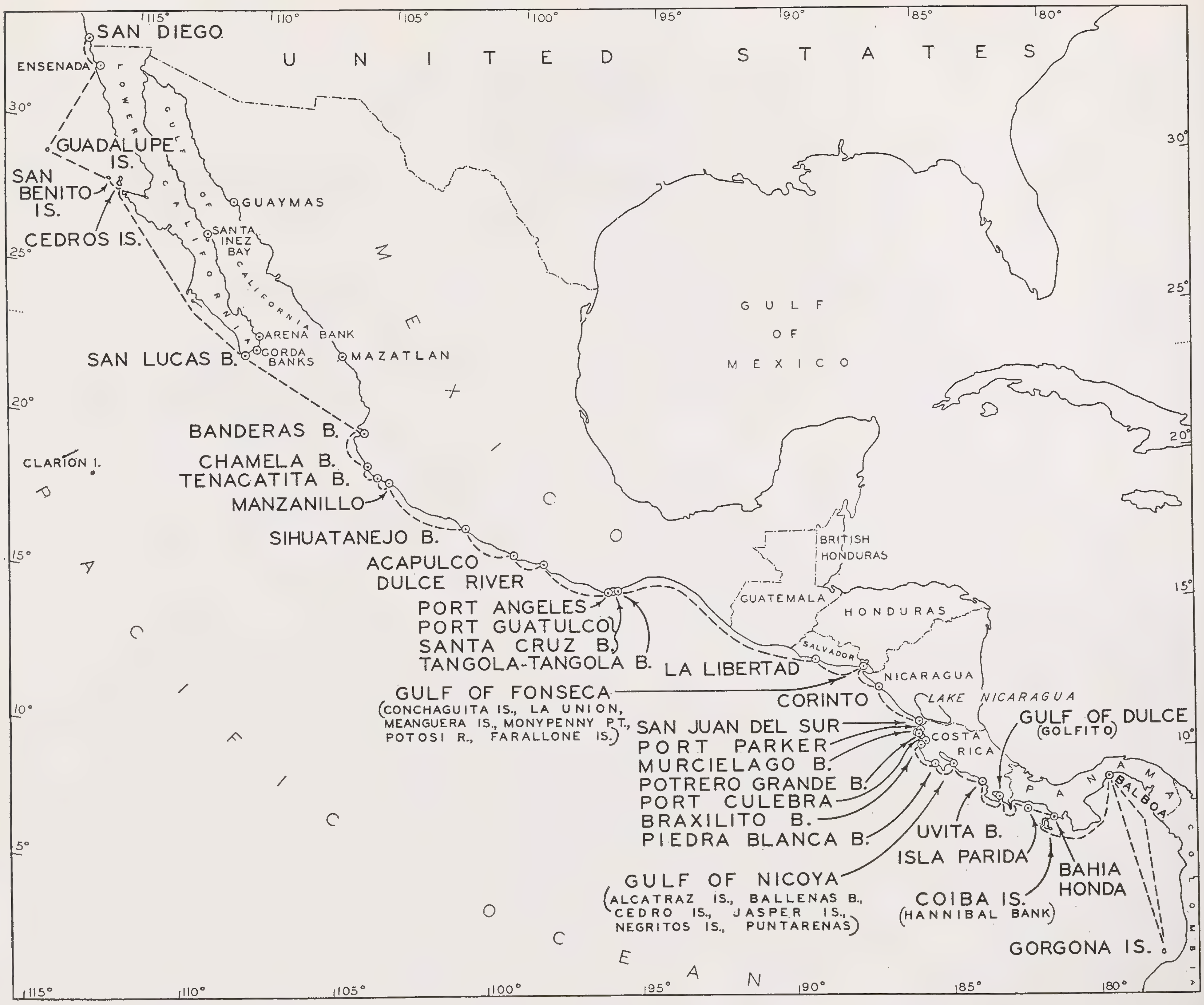


Along the course traced by the broken line the Zaca *moved slowly down the west coast, dipping into some forty bays and touching at Gorgona Island as its southernmost point.*

In euphony, the names of the bays of this coast rival those of the islands of the South Seas: Banderas, Chamela, Tenacatita, Sihuatanejo, Rio Dulce, Angeles, Guatulco, Santa Cruz, Tangola-Tangola, Fonseca, Murcielago, Potrero Grande, Culebra, Braxilito, Piedra Blanca, Nicoya, Uvita, Golfito, Bahia Honda and Chiriqui.

As before, Mr. Crocker accompanied the expedition, and interested himself especially in the cataloguing and preliminary identification of mollusks, as well as in shooting desired specimens of birds and catching gamefish. His friend, Mr. Maurice Willows, was with the *Zaca* as far as Puntarenas, and made gamefishing and insect collecting his special fields of endeavor. The physician of the expedition was Dr. Eric Liljencrantz of Stamford. There was, fortunately, no serious work for him on the *Zaca*, but again and again he was summoned by radio to cases of life and death on various tunaboats along our course. Toshio Asaeda carried on his usual excellent and thorough work as photographer and preparateur.

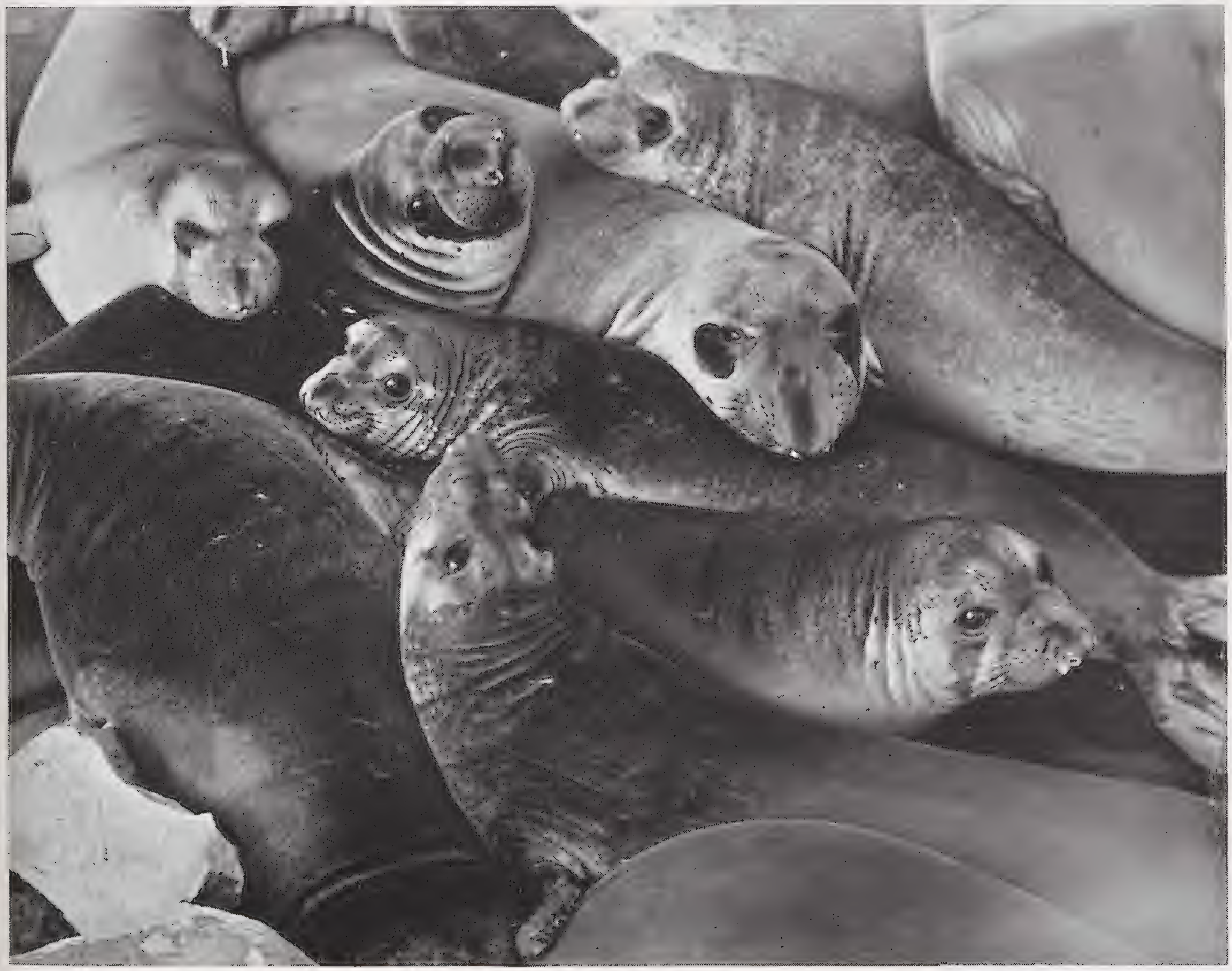
The Zoological Society's scientific personnel was the same as on the 1936 expedition, William Beebe, Director; John Tee-Van, General Associate; Jocelyn Crane, Technical Associate, and George Swanson, Artist.

Our chief object was to study as thoroughly as possible the fish, crabs and mollusks from tide-pools down to five hundred fathoms, with more emphasis placed on ecological relationships, colors and habits than on collecting. Constantly in mind, as a major problem, was the accumulation of field data of use in evaluating the relationship of corresponding Atlantic and Pacific forms.

Political boundaries, as I have said, were practically non-existent to our conscious minds, but geographical configurations occasionally forcibly concerned us. Throughout the entire five months we enjoyed almost perfect weather, with two exceptions: There are two decided openings in the 2,500-mile extent of the Sierra mountain ranges, one at the narrow neck of Tehuantepec, and the other where the great lake of Nicaragua opens up a wide watery gap. The northers of the Gulf of Mexico sweep across to the Pacific in sudden dangerous "Tehuantepeckers" for six months in the year, and farther south the corresponding storms raging across the great lake are known as "Papagayos." Except for these two intervals, the Pacific lived up to its name.

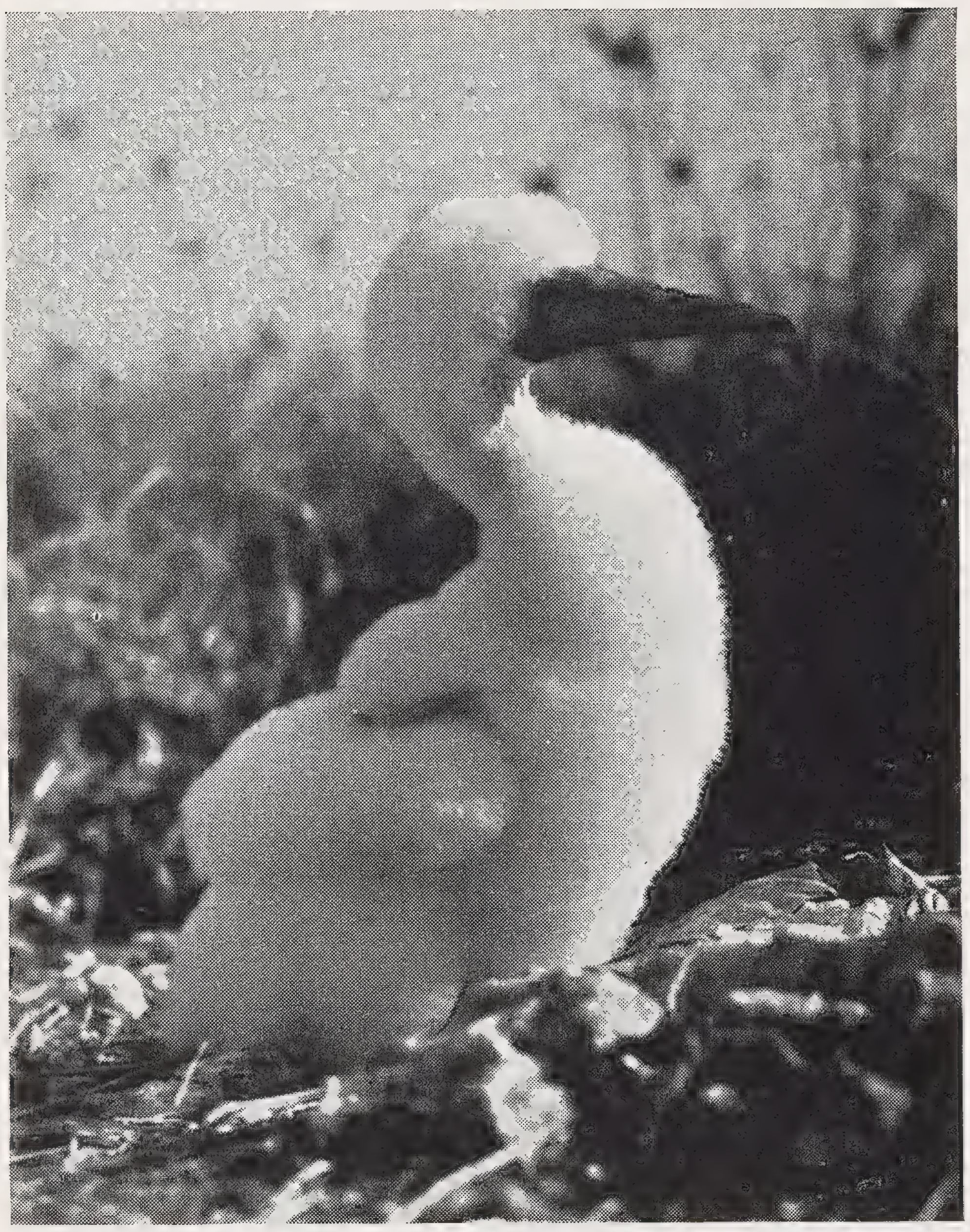
In the present treatment I can hope to give only a few highlights of the expedition. Two days after leaving San Diego we rowed ashore to the desert island of Guadalupe and there spent the day with sea elephants, huge creatures which live halfway lives between the fauna of land and that of water. In the direction of a purely oceanic life they have progressed well beyond sea lions, but are still far from the perfected aquatic goal of porpoises and whales.

As in the hippopotamus and whale, tendency toward more or less continued submergence in a liquid element has resulted in gigantism in the sea elephant. Full-grown males may reach twenty feet in length. They seem possessed by a perpetual drowsiness when on land, and at our approach opened their eyes only for a brief space, and then returned to slumber. They deserve and will have an entire chapter.



Photograph by Toshio Asaeda

Guadalupe is the last stronghold of the sea elephants, which crowd together on the beach and doze all day. They have almost no fear of human beings and at our approach opened their eyes for a moment and returned to slumber. The Mexican Government protects them.



Photograph by John Tee-Van

After a difficult climb to the top of one of the Tres Marietas I came face to face with this down-covered booby nestling.

With almost never a human eye to see and appreciate, this part of the Pacific offers exhibit after exhibit of superlative zoological interest. Only one hundred and sixty miles to the east of Guadalupe, the group of San Benito Islands rises above the surface. In strong contrast with the steep picturesqueness of the former, these islands are low and flat. And instead of the great helpless bodies of sea elephants static upon the beach, sea lions by the hundred came rushing down to the water at our approach. They appeared inspired both by fear and curiosity. Although they could gallop rapidly over dry land, yet only after diving through the breakers did they regain confidence and indulge to the full their absorbing interest in us and our boats. This faith in water was so complete that when alarmed they chose to take the shortest route, even if it led directly toward us. When I stepped out of the boat into a foot or two of water I was almost knocked over by the rush of cubs splashing past into deep water astern. The lack of blubber and a valuable under-coat of sealskin have preserved these interesting creatures from extermination. For years the Mexicans have guarded both Guadalupe and the San Benitos. Now there is a rumor that soon the conservation of the latter islands is to be stopped, and a contract let for the reduction of all these splendid animals to canned dog meat. It seems, at times, as if man were slowly but surely losing his prestige as trustee of wild life upon the planet.

Five hours after the roars of the sea lions died down we were dredging in Cedros Island channel, duplicating our hauls of twenty months ago in the same place. Then on to San Lucas and the ever more wonderful Frailes. Here I again dived at the Garden of Eels and again made an attempt to obtain one of the elusive burrowers. Disdaining the bang-bang, as we called the dynamite cap, I exploded a full stick of dynamite close over their holes, scrambling into the boat before the explosion. When I rapidly donned helmet and descended, I found a shell-hole in the sand and no signs of the magic eels.

Banderas was the first of our forty-odd-bays-to-come and was typical of the semi-arid northern third of our trip. Unlike almost all of the

Photograph by Toshio Asaeda

The northern part of the Zaca's *trip was past desert plains and mountains with giant cacti sprouting from parched soil.*

others, memory of this bay brings back no single outstanding character or happening in regard to our work. The little village, like a Hollywood set, and the famous oysters on the north side of the bay, come vividly to mind. I dived for the latter and found the water foul with mud, so that I had to grope about in utter blackness over a bottom covered with all manner of sharp and spiny unseen things, finally lugging up a few stones which were, however, covered with the allegedly dainty mollusks.

We were half-drowned landing on the Tres Marietas in a wicked swell, but managed to get our equipment on the rock by well-directed throws when the boat rose to the correct height. With the help of a rope we clambered to the top of one of the islets, and found a populous booby colony which had been waiting, who can tell how long, for the arrival of our cameras.

Chamela looked so good that we stayed three days and found it worth while. I followed an aged Mexican whose equally ancient horse clambered painfully around the stones on a burro trail. There fluttered into sight without warning one of the largest and loveliest morpho butterflies I have ever seen. This was too far north for any of the tropical iridescent blue giants, but here, among cactus and chaparral, came this glory with great pearly-white wings like watered silk, measuring about six inches across, faintly marked with a series of small pigment rings and an orange eye on the hind wings. Its appearance in this place was as unexpected as would have been an ant two feet in length.

Here in Chamela we explored the first of many lagoons, blocked from the sea by only a spit of sand, whose fresh or brackish waters

Photograph by John Tee-Van

Acapulco, Mexico, is the most beautiful of Central American cities on the Pacific coast. We caught specimens of fish along the shore, on the reefs, and even flew close to the water, watching the sharks and giant groupers lying outside the surf.

Photograph by Toshio Asaeda

The shallow draft of the Zaca *permitted her to anchor close to shore in almost unknown bays. Rocky shores yielded tide-pool fish, while along the sandy beaches the large seine was in almost constant use and almost every haul brought many specimens.*

were to yield us many interesting fish. We carried our portable boat over the bar and rowed far up among the mangroves to the beginning of high ground. Birds were abundant, twenty species of wading birds alone, eight herons including boatbills, besides ibises, curlews, kingfishers and delightful little vermilion flycatchers.

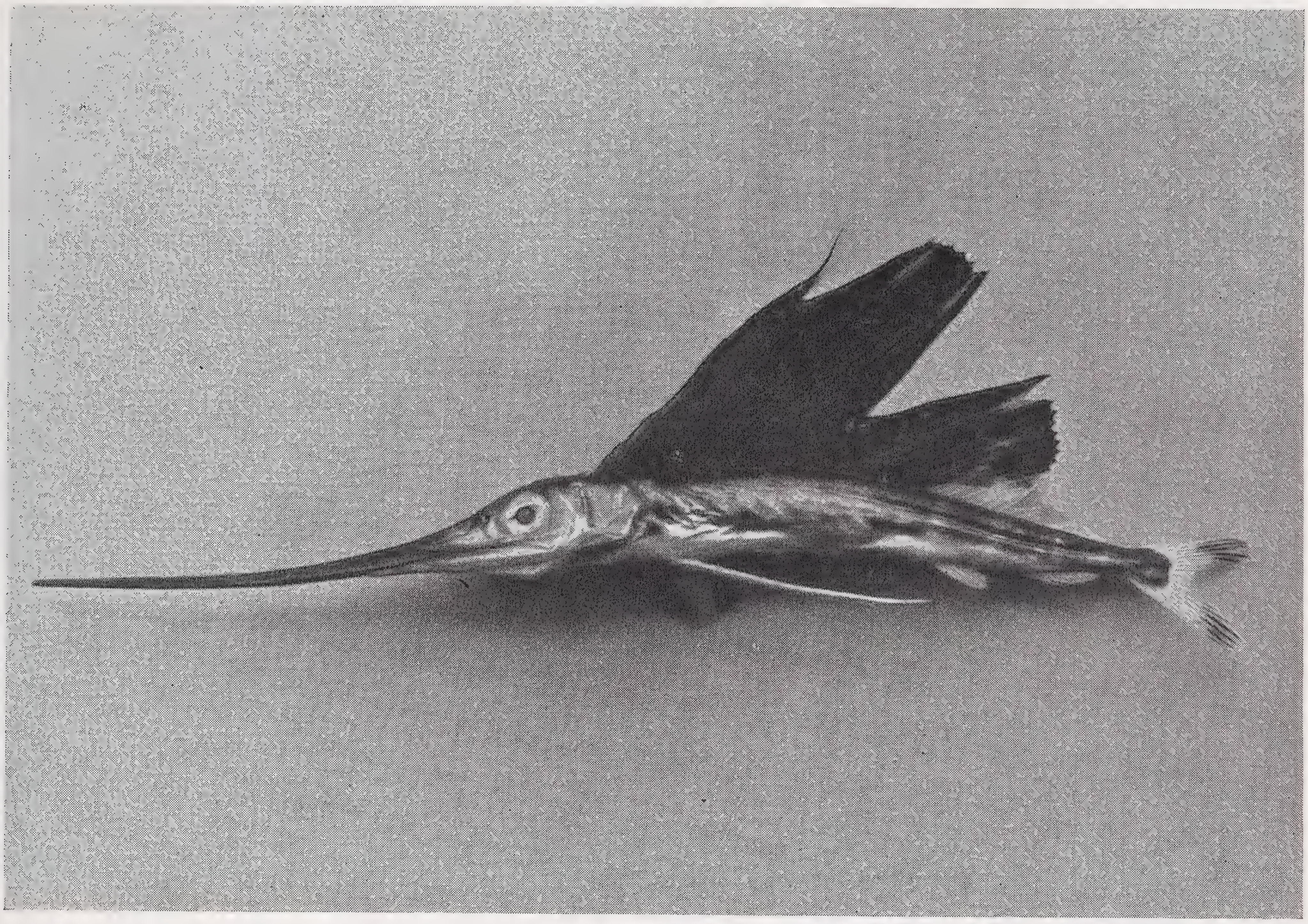
Then on to Manzanillo where one night all the moonfish in the world came to our submerged light and never ceased a clock-wise aquatic hegira—around and around—incredibly flat sheets of silver, now and then snatching and swallowing small but thicker fish which somehow magicked themselves within, without causing appreciable distension.

When we left, we drew two, and only two, dredges. Like the miraculous draught of fishes the gravelly sand which came up contained such richness that midnight found us only partway through our studies and drawings.

Acapulco's highlight was, for me, a flight along many miles of shore—holding down the plane to the dangerous level of two hundred feet. Every shark, great grouper and ray was clearly visible through the clear water, and never have I had a better demonstration of the abundance and size of creatures just outside the white lines of breakers.

Guatulco had a no man's land between surf and jungle—a sandfly zone where human beings could not linger. Like the two areas of storm, the insect pests were concentrated in a few places. Ticks and bêtes rouges held few worries for those of us who eschewed high laced boots and kept to the shorts and sneakers which for two decades we have found most suitable both for desert and jungle wear.

As usual on every trip and wherever we have gone on expeditions, poisonous snakes were played up by the natives. And as usual they were few and far between. In the course of forty bays and many miles of tramping I can recall but two baby fer-de-lance, both of which I caught alive. Even harmless serpents were



Photograph by Toshio Asaeda

The first baby sailfish, three and one-quarter inches long, came to our submarine light off Acapulco. Later a baby that was only one and three-quarter inches long came to the submerged light and was scooped up. Its proportions were typical of the adults.

rarely encountered. Sea snakes were common in places and I succeeded at last in obtaining well-grown embryos and in making notes on stranded individuals.

As we worked our way southward the mountain ranges became still more majestic, active volcanos came within sight and, as at Fonseca, we sometimes carried on our work close to steaming, roaring fumeroles.

Both in the careful preparations for this trip and the subsequent thinking over of our experiences no new means came to mind of securing fish other than those we brought into play. Submerged night lights were used whenever possible and our lists are of unbelievable length and unexpected character. At midnight on November 23, Ben, our expert gamefish launchman, scooped up a small fish which proved to be a young sailfish. The smallest Pacific individual ever taken weighed sixty-five pounds, so here was the world's record, measuring three and a quarter inches over all. Two months later and more than a thousand miles to the south, we broke our own sailfish record, for there came to the light and was scooped up unharmed a perfect baby only one and three-quarters inches long. Its sail was high and typical and the general proportions were exactly those of a full-grown fish.

Seining was the especial province of the crew, and few sandy beaches escaped the hauls of the great eighty-foot net. Thousands of fish were sometimes taken at once, and gave us splendid opportunities to pick and choose. The trolling line astern garnered a generous harvest throughout the trip, and Mr. Crocker estimated that he and Mr. Willows caught more than a ton of gamefish, including sailfish and marlin, roosterfish, dorados, jacks and mackerel.

The waterglass and helmet gave glimpses of species which never came to net or hook, and dynamite caps and dynamite, or "bang-bang" and "bong," as we called them, were almost our best weapons. But ahead of all else was our tide-pool work — observations both day and night, and the unsportsmanlike but most effective copper sulphate and derris root. From one mighty pool not far outside the entrance of Bahia Honda we took seventy-one species of fish.

Whenever time and opportunity permitted, en route from one bay to another, we made a quick dash out to sea and drew our deep-sea nets. In the course of many such stations, hosts of new and strange creatures were added to our collections.

Although we made more than fifteen stops along the Mexican coast, it was from Nicaragua south to Panama that we found the largest and most productive bays. From San Juan del Sur we went inland to Lake Nicaragua by "gasolina." This is a two-seated Ford of sorts on railway wheels which rushed us through jungles to the consternation of monkeys, macaws and unwary Indians.

Cape Velas lies between Braxilito Bay and Piedra Blanca and appears to mark the exact boundary between the eternally blowing Papagayo and the perfect calm of the Pacific. When we had to recross this imaginary line to convey our doctor to a sick man on a tunaboat, the gale began and ended according to whether we were just north or south of this cape.

Port Parker I recall with the greatest vividness for in the eleven days we spent there I learned to know it thoroughly—its mountains, dry streambeds, shallows, coral reefs and glades of giant trees like English parks. Huge crocodiles lived among the muddy mangroves, no more dangerous than the timid tapirs which roamed the shore at night, or the tiny deer which bed on the dryer uplands. Mr. Crocker shot one of the latter and its flesh was venison of n'th delicacy.

The tide covered and uncovered a coral reef at the entrance, and this gave up to our labors crabs and fish of colors as lovely to the eye as their respective structures were contributory to science.

Nicoya was not satisfied with less than two weeks of our time and deserved a month. Its lagoons and islets yielded exciting largesse to seines, hooks and dredges. Several days at San José on the mountains a mile above the sea were full of interest and new friendships. Dr. Anastasio Alfaro, dean of scientists in all of Central America, met us, and with the new Director, Professor Juvenal Valerio, we went to the excellent museum, where, before we left, we were able to rearrange and identify the collections of crabs and fish. The kindness shown us by these gentlemen and by Dr. Beeche will ever remain a highlight of San José.

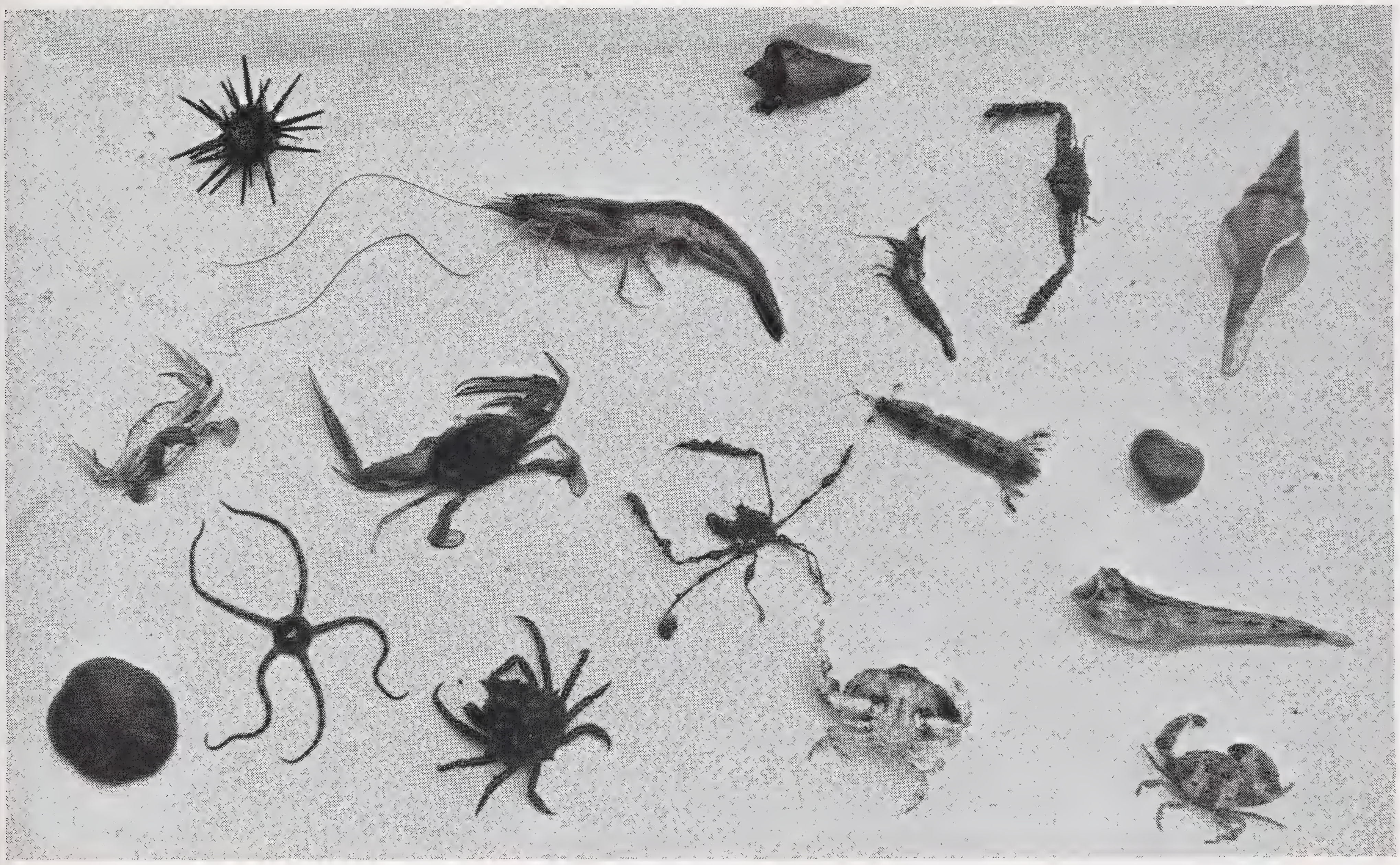
Dr. Ferdinand Nevermann was a man whom I hoped to make a close friend for the rest of my life. A keen and intelligent entomologist and naturalist in the broadest sense, he combined this scientific outlook with such a deep sense of kindliness and sympathy in discussion and human associations, that he took rank at once with William Morton Wheeler. That was in mid-February. Five months later, I read of his ghastly death, shot by accident by an American hunter in the jungle at night, near his own plantation.

Golfito, a tiny offshoot of the Gulf of Dulce, presented the essence of tropical rain forest, with consequent change in crabs, insects and birds. Here we became acquainted with the strange-toothed cichlids of the jungle streams, with the tide of the gars; here we met an incredibly dynamic, former naval diver submerged in the life of the people hereabouts, but producing a grimy, treasured book of clippings about the Zoological Society's bathysphere.

The last bay of importance was Bahia Honda, and during our sojourn of a week we were joined by and exchanged experiences with Commander and Mrs. W. K. Vanderbilt on the *Alva* and Mr. and Mrs. Hugh Chisholm on the *Aras*. Honda was rich in what we desired, and presented a personality wholly unlike any of the nine and thirty bays which we had already successively called home.

At the suggestion of Mr. Vanderbilt, we visited and dredged Hannibal Bank and found it worthy of his praise.

On March 22 we drew up alongside the wharf at Balboa, the identical Number Seven where in years past I had berthed the *Noma, Arcturus* and *Antares*. We oiled and watered and laundered in forty-eight hours and again put to sea. This time we headed, not for the Galápagos, but for a little-known island off the coast of Colombia—Gorgona. For six full days we explored and observed and collected on this in-



Photograph by Toshio Asaeda

Manzanillo proved a rich dredging ground and from a depth of thirty feet the net brought up a host of strange creatures—urchins, shrimps, shells, crabs, starfish, sand-dollars and fish. These are representatives of some of the many forms.

teresting two-by-six island, with its still more remarkable attendant islet, Gorgonilla. And we found what we had anticipated, that its fauna shared characters of the southern littoral area Chiliwards, with the Galápagos and the Panama zones of life.

The last deep sea net station, at a half mile depth at the very edge of the shallows of Panama Bay, brought up a worthy finale of Pacific abyssal fish life, among which were new genera and species of ceratioids, some with attached parasitic males.

Throughout the expedition the work of the department's staff went smoothly and well. With the advantage of our previous experience and the subordinating of mere collecting, we struck a satisfactory balance in preserving and recording which is not easy to do in the field amid the rush and excitement of each new day and scene.

Our artist, George Swanson, completed more than two hundred sheets of colored paintings, aggregating three hundred to four hundred individual drawings. They equal the work of any artist I have ever had.

Miss Jocelyn Crane devoted her whole time to crabs and secured specimens and a vast amount of life history data of upwards of two hundred species. Many of her subjects lived in deep holes in the mud of the mangroves, and in the course of intensive work in Bahia Honda she contracted a gnat-carried fever of a strange oriental type called Pappataci, which laid her low for the last two weeks of the expedition.

Mr. Tee-Van and I concentrated on fish. When we made a final calculation, we found that a full hundred thousand individuals were examined on the decks of the *Zaca,* representing a very generous percentage of all known on these coasts. Mr. Tee-Van developed a new and very thorough method of field cataloguing which is proving a most efficient time-saver in working up the collections. Toshio Asaeda outdid himself in the matter of photographing, and he together with Mr. Tee-Van made about twelve hundred splendid negatives.

On the return from Gorgona, two weeks were spent in Panama where I gave five addresses before various clubs and scientific societies, and renewed many old friendships. Several trips were made into the interior, the most interesting to the Cocle country and into the mountains as far as La Valle, at the invitation of Mr. and Mrs. Herbert Evans.

We arrived in New York on the *Santa Clara* on April 25. When, at our laboratory in the Zoological Park, we unpacked the three great shipments of cases and tanks, we realized what a wealth of material was ours; when we read through our volumes of notes and printed our photographs, we were certain that the trip had been a success from the point of view of increased knowledge of colors, food, habits and life histories. But as I reviewed the whole experience, I knew that the greatest personal result of the expedition was an acute awareness of my vast ignorance of the problems of the evolution, distribution and development of this splendid fauna which, for the first time, had come to my consciousness.

Photograph by John Tee-Van

The jungles of Golfito in Costa Rica were dense and tropical, and along the shore was always a fringe of coconut palms.

The banks of the Nepean River are a favorite site for the nests of the Australian Bee-eater, and in this district the author studied the curious life of the birds.

The Curious Australian Bee-eaters

Their Underground Nests Are Apparently Provided by Nature with a Supply of Food for the Young Birds

J. E. Ward

ONE of our well-known migratory birds in Australia is the Bee-eater, or Rainbow Bird, as it is commonly called on account of its semi-metallic sheen when on the wing, changing from blue green to golden copper as it moves gracefully in different angles in the sunlight.

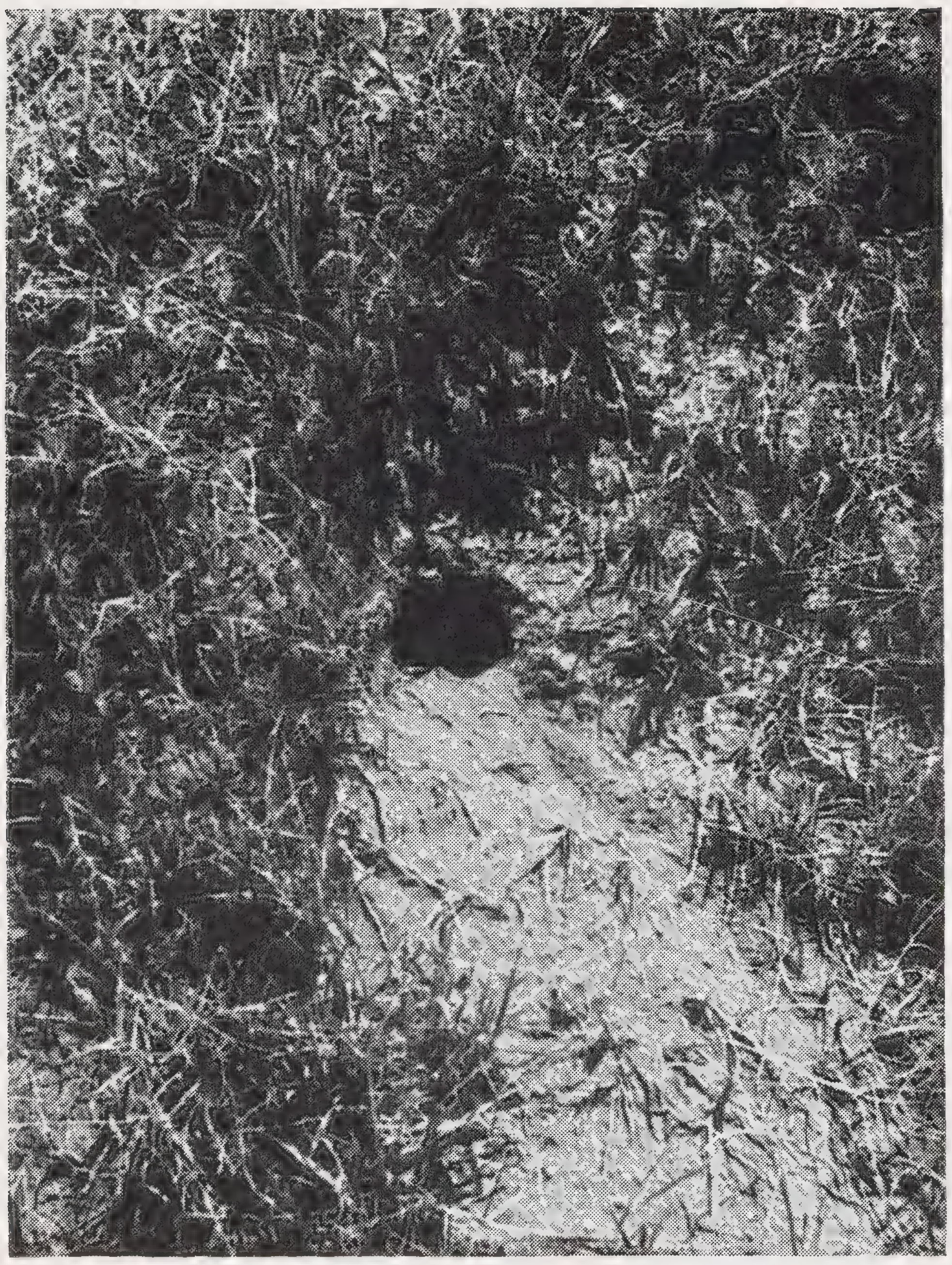
Very little has yet been written of the life and habits of the Bee-eaters. Speaking generally, it may be said that they are a purely arboreal group frequenting open and undulating country in the vicinity of fresh water rivers, passing the greater part of their time near their nests, sitting on the outermost branch of some dead limb and watching out for insects which they capture on the wing and which constitute their only food. The flight of the birds is undulating and graceful. From its dry and withered perch, the bird may be seen in pursuit of its prey, and when this has been captured the bird returns to the same perch in a circular motion, where after it has killed the insect it bolts it entire, even the largest dragon-flies. Later, like most of the insectivorous birds, it disgorges in pellets all undigested matter such as wings, legs, etc., of the insects, these disgorgings sometimes being termed casts.

Although most field naturalists are familiar with the habits of the adult Bee-eaters, the incubation and rearing of the young has never to my knowledge been recorded.

Only after many years of observation and with the desire to rear these beautiful birds from the nest have I been enabled to record the marvelous procedure adopted by Nature to propagate its kind.

The Bee-eaters have a wide range of distribu-

The photographs accompanying this article were taken by the author.



This is the entrance to a Bee-eater's nest, showing the two small ruts formed by the shuffling feet of the adults as they came and went during the incubation period.

tion over the greater part of the southern hemisphere, comprising several species with one or two known species in Europe. It is, however, with the Australian or South Sea species (*Merops ornatus*) that I am now dealing. This bird arrives in New South Wales from New Guinea and the Northern Territory of Australia early in October. Nesting operations commence almost immediately.

The perpendicular bank of a large river seems to be the most-favored locality for the bird's nest. A hole is tunnelled horizontally to the extent of three feet or more according to the density of the soil. At the end of the hole the nest is situated.

The four eggs which constitute a clutch are pure chalk-white and nearly round and they are laid on the bare earth, both birds taking part in their incubation. The hatching-out takes place at about the end of November, the young birds not leaving the nest until they are fully-fledged and able to fly expertly, which is about the first week in January. By the middle of March almost to a day, these families have departed along with the Dollar Birds to warmer climes.

After locating the adults by their monotonous but not unpleasant little trill at short intervals, one knows that the nest is in the close vicinity, perhaps only a few yards beneath the perch where the birds are located. There, in the sloping or perpendicular bank, a hole—a little more than one inch in diameter—is easily found; on close examination the mouth of the burrow will be seen to have two tiny ruts at the bottom which have been worn by the feet of the adult birds as they have shuffled in and out during the period of incubation and for the first fourteen days after the young have been hatched.

At this stage the young are covered entirely with long blood quills or so-called pin feathers, and they remain in that state until they are nearly full grown, when a sudden shedding of the outer covering of these quills takes place. Within a few hours the birds are fully feathered and closely resemble the parent birds. This same rapid development of the feathers may be noticed also in the nestlings of the Kingfishers, Jacamars, Rollers, and Mot Mots, to which the Bee-eaters are said to be closely allied.

The young Bee-eaters when in the nest lie flat out, huddled together, their eyes only slightly open, their flat heads and large beaks giving them a somewhat sly and leering expression that resembles that of a reptile more than that of a bird. "Alligators," perhaps, would be the first impression when one opens a nest of young birds, so uncanny and forbidding do they appear.

There is no reaching up with wide-open gape in the expectancy of food as with nearly all young nestlings. They seem to sense from the beginning when food is brought to the nest and they are able to take it from the beak of the parents, but will refuse to take food of any kind offered to them otherwise. This fact makes it a tedious and difficult matter that entails a vast amount of time and patience to rear the young birds by hand. The adult birds also refuse to take food, no matter how they are tempted; they merely sit sulkily on the perch. Perhaps this may only be the result of fretting on account of having been captured at the nest—the only possible means of securing them so far as I know.

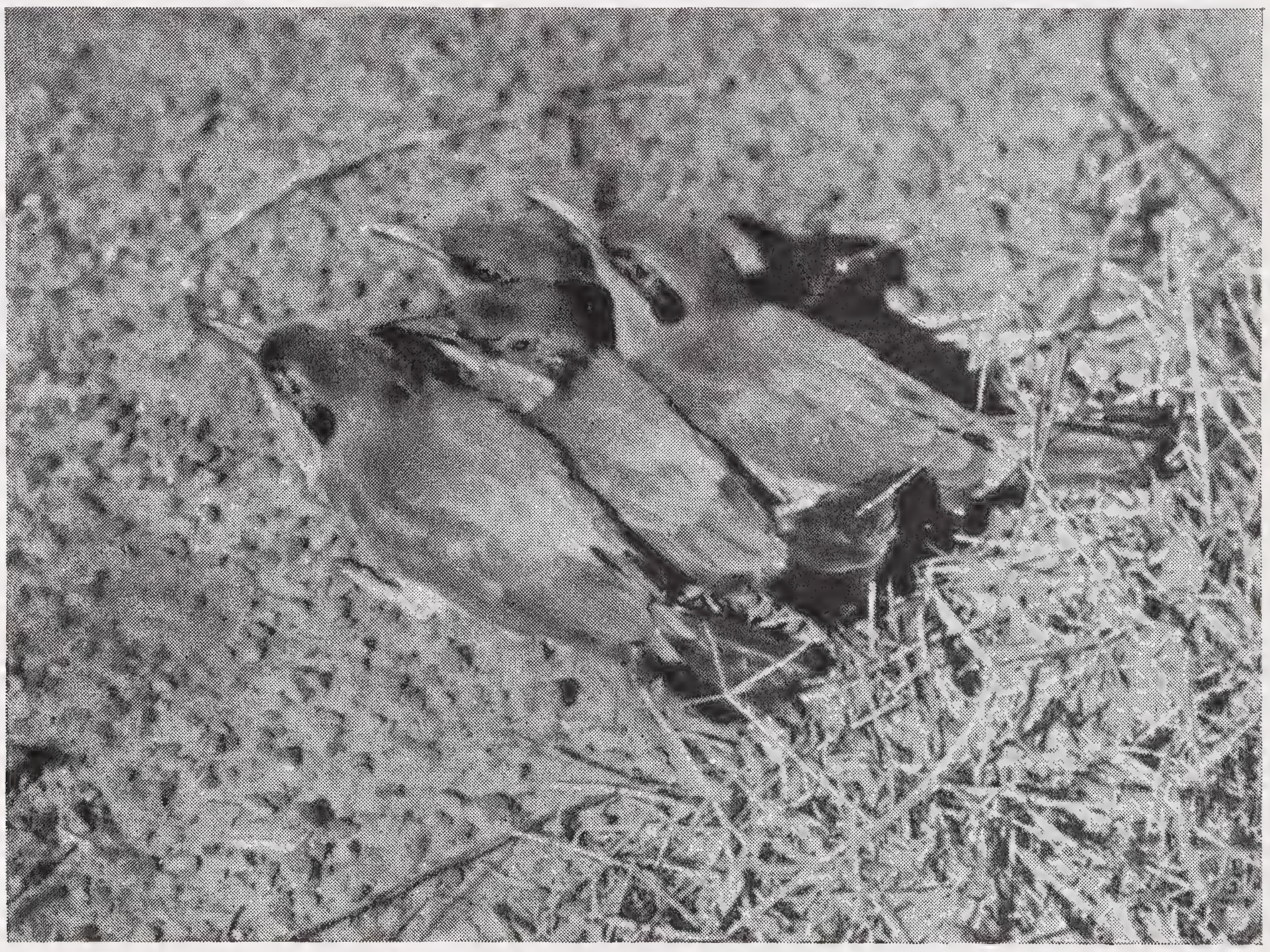
In the foregoing, up to a certain point, there is little difference in the method of incubation from that of other nidicolous birds. But this reminds me that I have to record one more of Nature's mysteries which causes us to wonder why, and how, this amazing method of food supply for the young Bee-eaters came about, for the young birds themselves are the very means of supplying most of the food for their own subsistence.

It was on a blistering hot day in January that, along with a friend who, by the way, is not a "bird man," I was digging out a burrow in the bank of the Nepean River, one of several burrows that I had located a few weeks earlier. After excavating more than two feet with a large, half-round trowel I started to scrape away by hand the remaining soft, sandy soil near the nest chamber. At a full arm's length I could with difficulty just reach it and I made an effort to grab, as I thought, some of the young ones. To my surprise I found they were quite cold and stiff and were evidently dead. Disconcerted but curious, I determined to investigate further and made a more vigorous effort to drag one out, when suddenly I realized that I was trying to get my fingers around the coil of a snake which was curled up in the nest, and which fortunately for me was asleep. After killing the reptile with successive, hard prods with a stick we extracted it from the hole and saw what appeared to be the shape of four young birds which it had eaten—which fact was proved by the dissection of what turned out to be a venomous Brown Snake five feet in length.

On reaching another burrow after this startling experience, we naturally hesitated and having rested awhile in the shade of one of the many willow trees that lined the banks of the river, we watched the old Bee-eaters which were perched on a wire fence. While discussing the probability that the snake had also visited this nest I wondered, as I had often done before, how was it that the old birds were so seldom seen to carry food to the nest? I knew that by this time the young birds were well-developed and like all insectivorous birds they would have voracious appetites. It was early in the day so we decided to watch until the nest was visited with food, which fact would indicate that the nestlings were there and alive. The old birds made many captures of flying insects but they always ate what they caught. Only once was the nest visited during a period of over two hours, after which I decided to dig the burrow out.

As the nest was situated only little more than one foot below the top of the bank I decided to dig down from the surface. This exposed the whole length of the burrow, at the extreme end of which the nest cavity was situated. In the latter four well-developed young birds were found, all flattened out and facing towards what had been the entrance of the tunnel. The birds shuffled back as far as possible as if to avoid the

Young Bee-eaters forty-eight hours after they have shed their outer covering of pin feathers. They are in this stage about fourteen days before leaving the nest.



light. The whole of the nest cavity and the bottom of the tunnel was thick with the refuse from the birds' casts, composed chiefly of the husks and wings of the green blow-fly. The nest proper was at least three to four inches deep in this refuse and at the bottom was a seething mass of maggots. In the hot soil beneath were the chrysalides or pupae of the flies in all stages.

Taking one of the young birds out, I placed it on the grass to see what would happen in regard to the old birds. Though only a few yards away, they were quite indifferent as the young one shuffled around, always in a backward motion and uttering awhile precisely the same call as the adults. Some time after having replaced the young one in the nest I noticed a slight movement on the top of the refuse. Immediately the birds, perhaps from a sense of hearing, became on the alert, as a large blow-fly, barely matured, crawled out from beneath them. There was a snapping of beaks to right and left and the fly was quickly caught and bolted to the accompaniment of a few chirps which seemed to indicate some sort of satisfaction. They then settled down to await the emergence of the next fly. Unfortunately for the birds, the next fly that made its appearance came out behind them. There was an undecided left to right movement of the heads again as the fly made progress towards the light, it being quite obvious that the birds did not depend on their sight at this stage to locate their food, for their eyes were still mere slits. Their vision, be it ever so keen, would avail them little in the nest. Always facing the entrance, the birds know from one of those various inborn instincts that each fly, as it matures, will make toward the outlet in order to escape—but with little hope of success, for I have never seen a fly emerge from any of the many scores of nests that I have had under observation.

This very remarkable phase of bird life, in which instincts assert themselves with such force, applies as much to the fly as to the birds themselves. One wonders how came the fly, which seems to be regarded as a special diet by the birds, to enter the burrow and blow its eggs in the nest cavity? Perhaps it is one of those marvelous and unaccountable understandings between creatures of insect and animal life, applied in so many of Nature's mysteries, which helps to preserve the balance of Nature.

Let us investigate and see just what takes place.

From the time the eggs are laid and during the whole period of incubation the old birds continue to foul the nest with their excreta, which is more or less in liquid form. They also during that time disgorge the pellets of refuse —this probably to provide a soft and cleaner lining for the expectant hatching of the young. Attracted by the strong odor, the flies use the nest as an incubator where the maggots mature into the chrysalis form from which the fly eventually makes its appearance. Soon the seething mass of maggots under the refuse creates a great heat and for this reason it is scarcely necessary for the old birds to sit on their young after the first few days. This fact would account for their somewhat protracted absence from the nest, for the young are soon able to snap up the flies as they mature and also strong enough to disgorge any indigestible matter.

This process continues for about twenty-one days, when the young birds may then only be distinguished from the adults by their diffused coloration. On close examination of a nest immediately after the brood has flown, one is astounded at the great accumulation of refuse. In fact it has become so over-crowded that one fine morning the birds decide it is time to leave their close confinement, which they do in quick succession and appear to be as expert in flight as the adults.

Bee-eaters when reared by hand become extremely tame and attached to their owner. When liberated they never stray further than to catch a passing insect, after which they will alight on the nearest fence or telephone wire, returning at once to a given call, alighting then on one's head or shoulders and expecting some dainty such as a moth or mealworm. The extreme tameness of the birds is not from any admiration of their owners, but like so many birds that are hand-reared, the result of an association with food.

As the season advances and the time for their migration has come, the birds, if left at liberty for any length of time, will gradually stray but always in a northerly direction. Getting well up in the air they drift away in circles, while they utter their monotonous little calls all the while.

I well remember many years ago, in 1911 to be exact, one evening late in March when I saw four birds of mine well on the wing. I followed them for over a mile when they decided at last to look for a suitable resting place for the night. An immense fig tree seemed to be to their liking and circling this for a number of times, they eventually settled there. When I gave the well-known call they immediately answered and at last flew down onto my head and shoulders, much to the amazement of a few workmen who were homeward bound and had stopped to watch me.

"Well," said one of these fellows, as I gathered the birds in, "I thought the bloke was balmy. Fancy catching parrots with his hand like that!"

"Parrots!" said his mate, "Don't you know Kingfishers when you see them?"

Two of these same birds were later sent by me to Mr. Seth-Smith, Curator of Birds at the London Zoological Gardens, where they were exhibited that same year, they being the first of our species of Bee-eaters ever to reach England.

Keeping the Animals Well

That, Instead of the More Dramatic Business of Healing Them, Is the Primary Duty of the Veterinary Department

William Bridges

"WE HEAR you've got a wonderful Hospital for sick animals at the Zoo, and we'd like to prepare a radio program in the form of an interview with the Doctor," said the voice over the phone.

"Well . . . just what sort of a program do you have in mind? There isn't anything very dramatic about it—mostly laboratory work and sanitation, you know. Don't you people generally have to put excitement into your programs?"

"Oh, I'm sure we can find the sort of thing we want. When shall we send someone up to get first-hand information?"

"All right; send your man any time—but the script has to be passed by the Veterinarian before it can be presented. Is that understood?"

"Quite."

So the young man came to the Zoological Park. He spent the greater part of a whole day with Dr. Charles R. Schroeder. He made the rounds of the buildings on the Veterinarian's morning tour of inspection, he asked innumerable questions, he took reams of notes in the laboratory and autopsy rooms while the stream of the daily routine flowed around him.

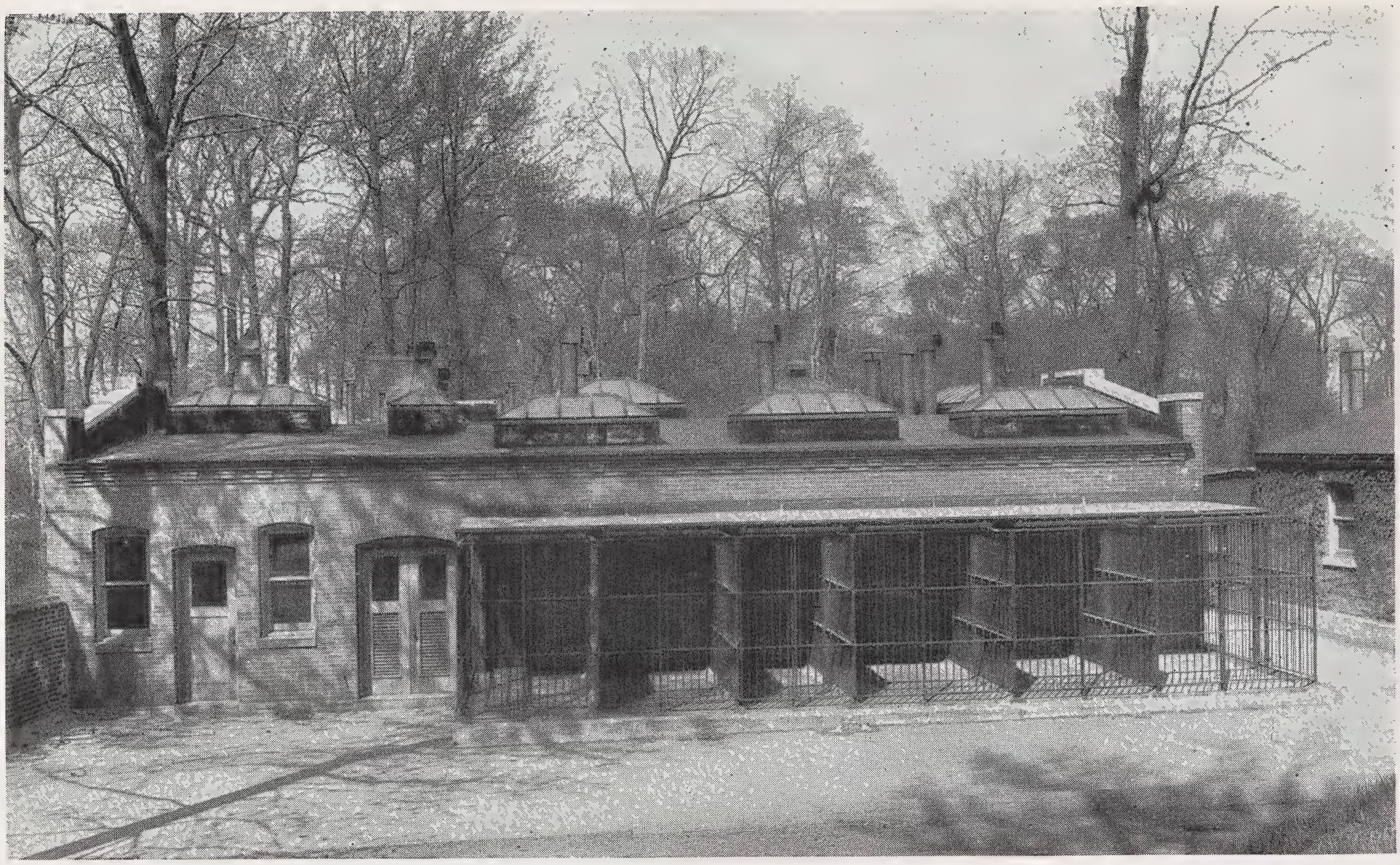
It happened to be one of the typical days—if there ever is a really typical day in the life of a veterinarian. At any rate, there were no violently exciting incidents. Research men came and went about their business of making post-mortem examinations, a keeper or two were instructed about changes in diet for their animals, from time to time the sterilizing apparatus was charged with batches of glassware and feeding pans. Little racks of glass tubes containing something that looked like lemon jell-o were slipped into a cabinet that periodically gave forth a blinking light from a bulb in its top. A man in a coarse brown smock bent interminably over a microscope and fiddled endlessly with its adjustments.

It was, in short, a normal working day. I couldn't for the life of me see what radio's young man was going to make a program out of. But maybe he was going to invent a new kind.

Eventually the young man took his departure. He seemed satisfied. He was cordial, and assured the Veterinarian that he had the makings of a grand program. The Veterinarian was instructed to appear at the studio some days hence to run through a rehearsal of the finished script.

He did so. I wasn't there, but I heard from Dr. Schroeder what happened.

"They sat me down and brought in a crew of actors to run through the thing and read



In the heart of the service yard is the Animal Hospital. Here it is isolated from the other animal buildings and from the bustle of visitors. Patients in the outside cages, open to the sun, are not disturbed except by an occasional workman passing through the yard.

my part in the interview. It started off something like this:

"'I am the Veterinary at the New York Zoo. I handle the sick animals. I remember the time when we threw a two-ton hippopotamus on a pile of mattresses and pulled one of his teeth. It was four-by-six inches and it weighed ten pounds.'

"Right then I jumped up as if that mythical hippo had gored me. We had a scene—and it wasn't rehearsed, either. Well, to make a very long story short, that program didn't go on the air!"

Dr. Schroeder tells the story with all the accents of outraged ethics. But, in a way, the radio people cannot be blamed for attempting to heighten the appeal of the notes their reporter brought back. Here is an Animal Doctor in a big zoo, who is supposed to cure dangerous lions and elephants and cobras, and all he can show a reporter is some diet formulas and scrubbing brushes and tubes of mouldy jelly! Nobody would listen to that kind of a program for half a minute.

There *are* dangers and thrills in the life of a Veterinarian, but unfortunately they seldom take a dramatic form. Autopsies on dead animals are extremely important in a zoological park, not only because you learn something about disease but because you may be able to prevent similar deaths. Autopsies sometimes disclose virulent and highly dangerous organisms—highly dangerous to humans. That is why the men working in the post-mortem room wear long rubber gloves and wash their hands carefully and are watchful of the small cuts and abrasions of their own skin. There is always a danger of infection, and it is much more serious than the danger of being bitten, gored or clawed by a living animal.

And there are plenty of thrills, too. But they are the thrills of identifying a new organism, or demonstrating an unusual pathological condition, or seeing an experimental treatment working out successfully.

In this article about the Veterinary Department of the New York Zoological Park there are no stories about the Veterinarian's dramatic wrestling match with a pain-maddened tiger or his exciting struggle to subdue a hippopotamus.

At the rear of the Hospital is a large concrete platform and a hoist used for lifting heavy animals for post-mortem examination. The screened door gives access to the autopsy room, and here the viscera are taken for a more detailed examination on the table.

There is no denying that emergencies do occur from time to time. Years ago there were some lively times in the Veterinarian's domain when a tiger got a splinter of bone caught between its teeth, and on another occasion when a bear punctured its lip with its own tooth. But such incidents are rare and most of them could be handled by a cool and resourceful Keeper as efficiently as by the Veterinarian.

Instead, the story of the Veterinary Department is chiefly one of disease *prevention,* and only secondarily of disease treatment.

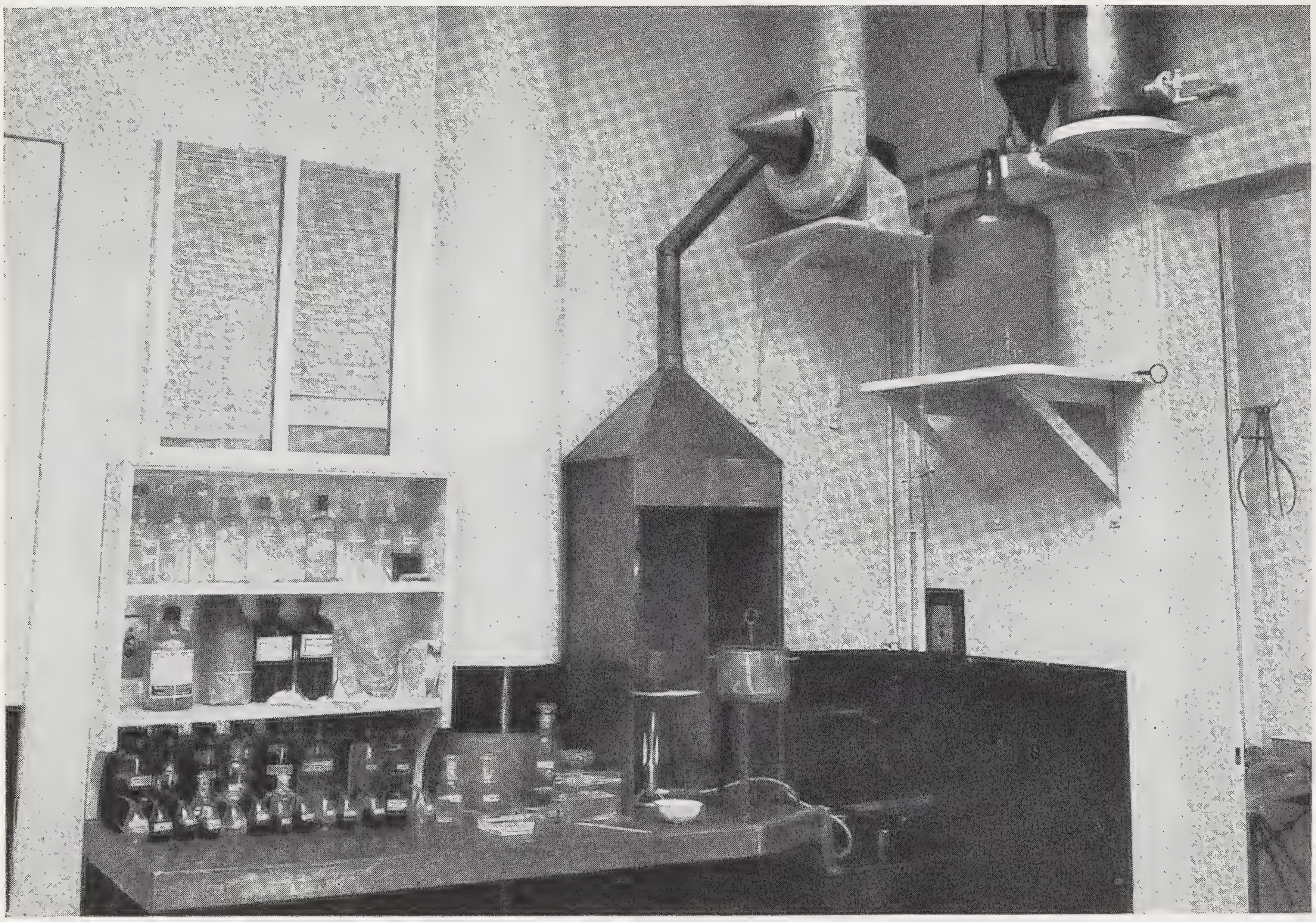
Only three or four of the larger American zoological gardens have full-time Veterinary Departments. The others depend on outside practicing Veterinarians who are on call for the treatment of individual cases of disease or injury.

Our department was created at the very beginning of the Zoological Park, and its first office was in the building which now houses the business and editorial departments. The basis for the present work was laid down by Dr. Blair during his long service as Veterinarian, and was continued under the late Dr. Noback. When Dr. Schroeder came to us from the San Diego Zoological Garden's Hospital in 1937, the activities of the Laboratory in particular were expanded. Considerable new equipment was bought. Structural changes were made in the Animal Kitchen for better control of hygiene and sanitation. A more intensive study of the causes of deaths in the collection was undertaken through several channels. A system of records, which were outlined in the Department's section of the 1937 *Annual Report,* was set up early last year.

As Dr. Schroeder wrote in that *Report,* "It is the business of the staff of the Laboratory and Hospital to maintain or improve the longevity rate" of the animals in the collection. That is a simple and obvious statement, but it has wide implications and involves many functions that are not apparent at first glance.

Ideally, no zoological park would admit into its collection any but perfectly normal, healthy animals, which it would maintain under such hygienic conditions that at long last they would be retired for mere age.

That condition actually does obtain in a sur-



In this corner of the Laboratory are the chemical hood, distilled water apparatus, and staining table. Here diagnostic smears are prepared, analyses made, and blood chemistry work carried out. The door at the extreme right leads into the autopsy room.

prisingly large number of animals. Many specimens in well-run zoos live far beyond the age they could expect to attain under the strenuous conditions of the wild. But others run a hazard of disease that shortens their rate of survival, and it is here that the Veterinary Department concentrates its attack.

One of the preliminary jobs of the Veterinarian is to stand on the threshold of the zoo and welcome or repel animal newcomers accordingly as their health records are good or bad. After an examination he can generally advise for or against the purchase of an animal or its acceptance as a gift.

Some of that work is done for him. The strict importation and quarantine regulations of the Federal Bureau of Animal Industry are a guarantee against certain types of disease. Readers of the *Bulletin* will recall the elaborate precautions that Dr. Blair took last year to prevent the possible contact of the Okapi with the foot-and-mouth disease of Europe when the animal was trans-shipped at Antwerp. Even so the Okapi had to be quarantined for an additional period here in the Park, and when it was finally released from restrictions it was certainly free from foot-and-mouth disease.

Recently very strict rules have been made about the importation of birds of the parrot group. They were aimed at stamping out the almost invariably fatal disease of psittacosis.

Yet not all kinds of disease are screened out in this way. Tuberculosis, for example, is not a cause for refusing an animal admission to the United States. Nevertheless it can be extremely dangerous if a highly tuberculous animal is admitted into the company of a tuberculosis-free group in a zoo.

Many animals have parasites that they picked up in the wilds, and which under certain conditions would cause havoc in a captive collection. So, as a precaution against a whole host of possibilities, the Zoological Park sets up its own quarantine.

Some animals are in quarantine cages in the Hospital for weeks or months before they are seen by the public. No member of the parrot family, for instance, ever enters the collection, no matter where it comes from, until it has been minutely examined in the Hospital and held in isolation from others of its kind for at least 15 days. Some animals are in need of treatment for dietary deficiencies or minor disease and stay in the Hospital until they are well and healthy before being put on exhibition.

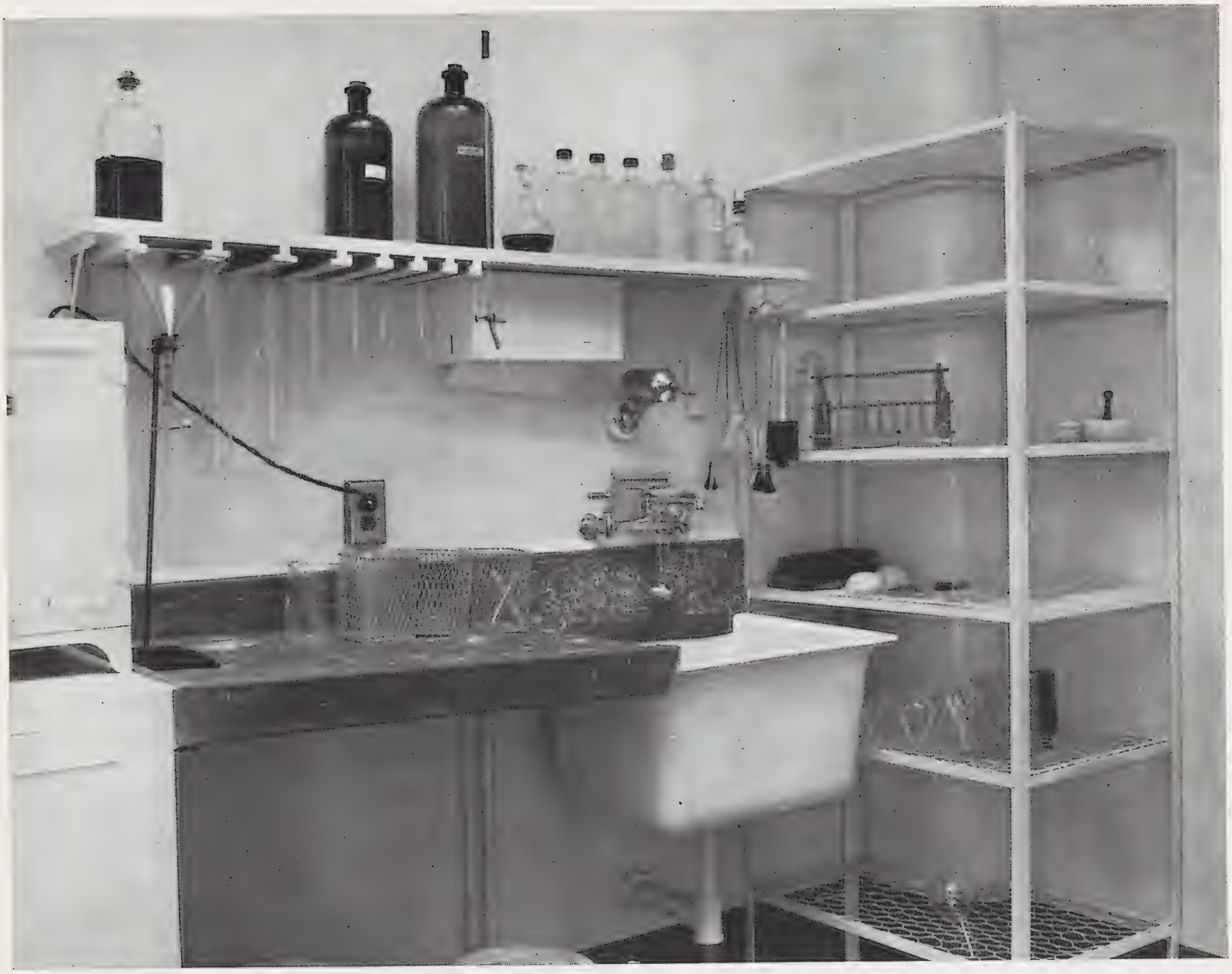
For some time past, for example, the liveliest inmate of the Hospital has been a young Orang-utan. When it came it was found to be suffering from an irritating but not dangerous skin disease, and a minor diet deficiency. It is responding well to treatment and soon will be able to enter the collection in the Primate House. Even if it had been put on exhibition immediately it probably would not have communicated its skin disease to other animals in the building, nor would the disease have been fatal. But it had to be cured first, and treatment can be made at the Hospital more easily than in an exhibition cage.

Some animals, of course, that appear to be free from communicable disease can be placed on "quarantine exhibition" immediately, if there is a cage or corral or range where they will not be with others of their own kind. So can occasional great rarities whose life-span is known to be short. But in every instance they are kept isolated from their kind unless they have been quarantined and certified free from transmissible disease.

During quarantine—and forever after—the kinds of bacteria, viruses, fungoid organisms, parasites and so on that must be watched for and eliminated are virtually countless. To take one problem, not necessarily as typical but for the sake of simplicity, the detection of tuberculosis in monkeys will serve to illustrate an important part of the Veterinarian's routine.

Monkeys probably never have a chance to

Identification of disease organisms requires a great deal of bacteriological work. Here bacteria are being cultured in glass tubes. Slides are being prepared by Dr. Schroeder (right) for microscopic examination in the black cabinet at the left by Dr. Herman.



The washing unit in the Laboratory consists of a lead-covered board and a many-shelved, wire drain rack. All used glassware is given a preliminary washing here with water and is allowed to drain before being placed in the autoclave, or sterilizing machine.

pick up tuberculosis in the wild state. Their resistence is low and they have many chances to contract the disease during the course of capture, shipment and housing in collections. Consequently many die of the disease.

It would be of the greatest value to zoos and research institutions if there was a test for tuberculosis that would detect the disease surely, quickly and easily. Many attempts have been made to work out such a diagnostic test. There is a fairly simple one that works with humans, but it is not very satisfactory when applied to the other primates. Some years ago the Penrose Laboratory of the Philadelphia Zoological Garden evolved a variation of an early type of cattle tuberculosis test that has been used with some success, but there was need for a simpler method that would give more certain results.

During the past summer Dr. Schroeder worked out a diagnostic method which seems to be satisfactory in several of the essentials. It is now undergoing a thorough tryout on a wholesale scale. Dr. Clarence Carpenter of Bard College is in Singapore collecting rhesus monkeys for Columbia University. He will test approximately 1,600 monkeys before purchasing them and ship only those which do not give a positive reaction to the tuberculin injections which are the basis of Dr. Schroeder's method. Presumably, if thoroughly hygienic conditions are maintained in shipment, as it is possible to do with supervision by someone who understands the hazards of contact with tuberculous humans, the greater part of that large shipment will reach New York with a very low percentage of mortality from tuberculosis.

By work of this kind, more and more knowledge is being gained about animal hygiene, and dealers and collectors are being educated to the necessity of protecting their animals against disease. In the long run it will mean a better mortality table for all animal collections.

At the present time every primate which enters the New York Zooogical Park is given the tuberculin test as a routine measure, and thus diseased specimens are eliminated before they have a chance to infect their mates.

In human medicine there are two methods of attack. One is the passive method of avoiding the causes of disease. The other is the active procedure of combatting it directly, by immunizing the body. The vaccination of children against scarlet fever and typhoid fever and the injection of diphtheria toxoid are commonplaces of human medicine.

Unfortunately, too little is known about the diseases caused by bacteria and viruses in wild animals to make great headway by immunization. Veterinarians in charge of wild animals, therefore, are forced to adopt the passive role of seeing that their animals either do not come in contact with disease or, if they do, are not overwhelmed by such heavy infections that their natural resistence succumbs.

That can be called the "passive" role only by courtesy. It means quarantine, parasite elimination, calming and reassuring the animal, mental rest, acclimatization to new temperatures, adjustment to new humidities, elimination of incurable and known carriers of disease, and absolute cleanliness. In practice the passive role demands a good deal of activity.

Sanitation and more sanitation is the basis of all disease prevention. Most animals do not mind "honest dirt," the earth, leaves and general debris that may stick to their food or become mixed with it. But the bacteria that destroy animals are invisible and it is up to the Veterinarian, with the cooperation of the Keepers, to see that disease does not gain a dangerous foothold.

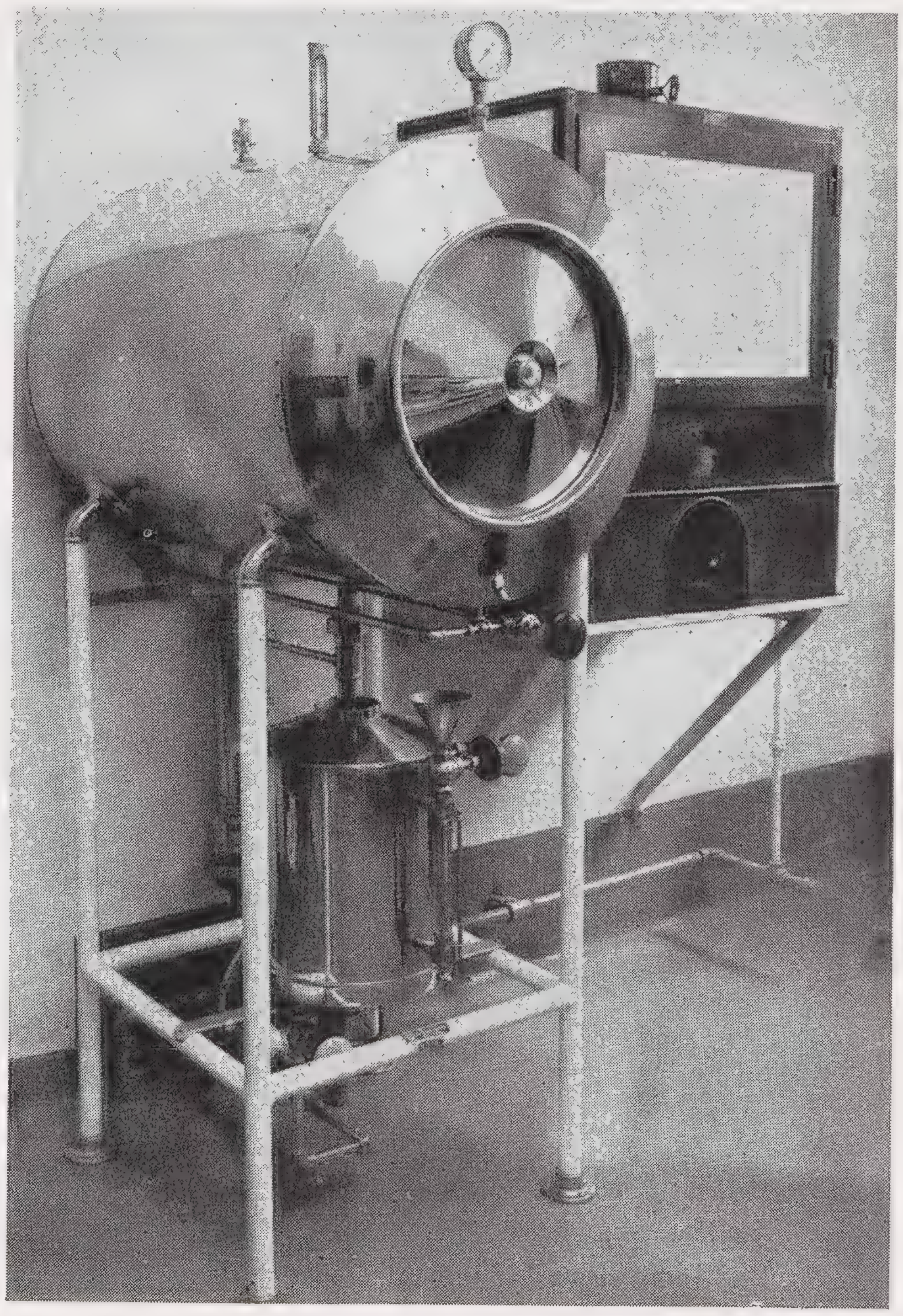
Most of the food for our collections is cut, cooked or mixed in the Animal Kitchen, and the kitchen is scrubbed with lye and hosed down with live steam every day. That is an elementary precaution against contaminated food and one that is supplemented, of course, by close supervision of incoming supplies.

In the animal buildings themselves the scrubbing brushes seldom get a chance to dry out. Various oxydizing agents that destroy bacteria are supplied in quantity to the Keepers and they are required to make liberal use of them. They scrub the walls and floors and drench the cracks and crevices.

Straw bedding throughout the Park has been replaced by a new type of bedding, a soft cushion of sterile, dried and shredded sugar cane that takes up moisture like blotting paper. It dries out the droppings of the animals and lessens the chances of infecting cagemates.

The diet of animals is such a specialized and important part of the Veterinary Department's work that it deserves an article by itself, and eventually will have one.

When careful selection of healthy specimens, quarantine and treatment, soap and water and attention to diet, have all played their part in the formation of an animal collection, animals still die. Pneumonias, tumors, ulcers, virus dis-



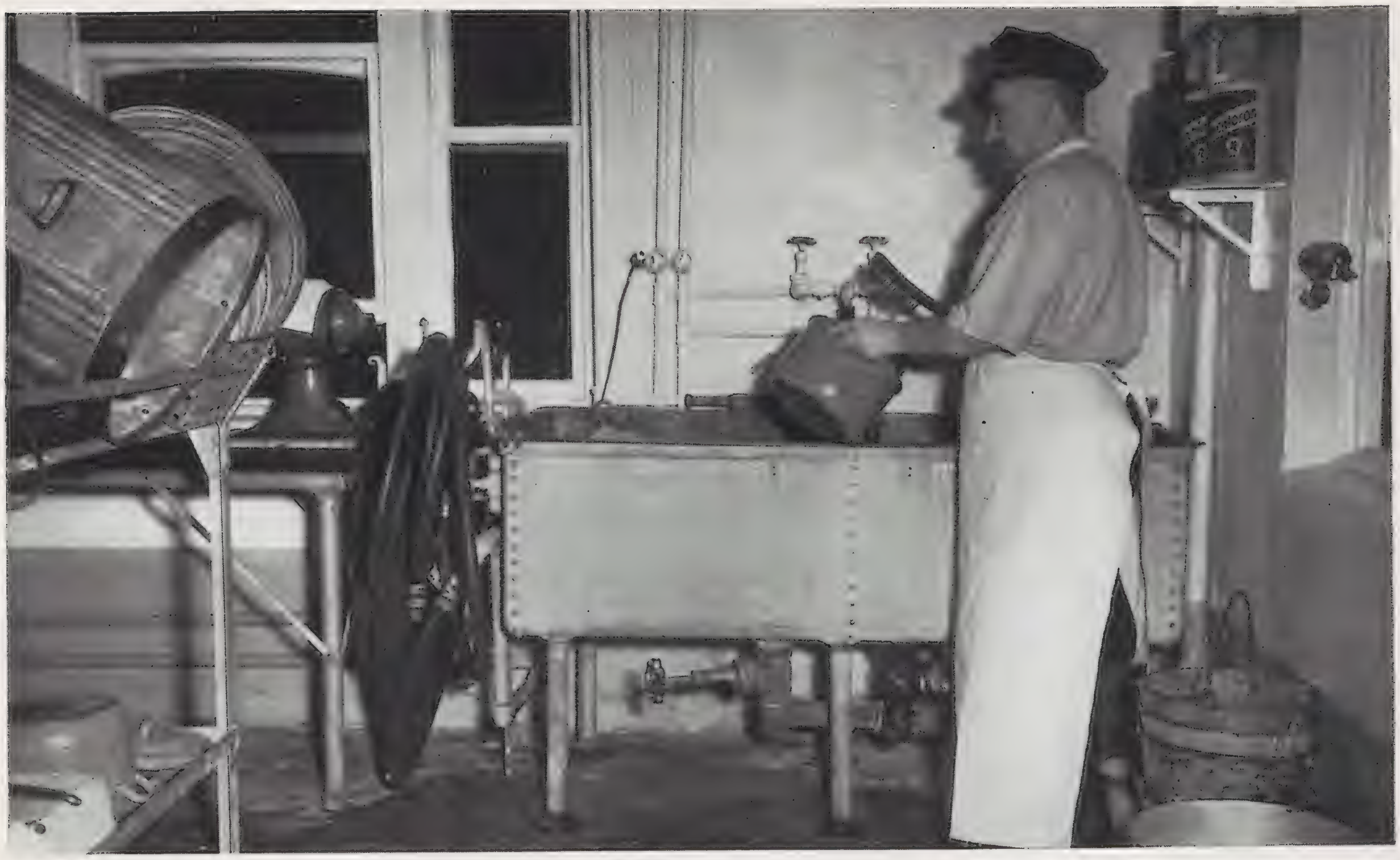
The steam autoclave (left) and hot air oven (right) sterilize everything in the Hospital. Even the doormats are sterilized.

The Surgery is a large, bright room lighted by a skylight directly over the operating table. Only the smaller animals are treated here. It is more practicable to handle any surgical cases among the larger animals in their own exhibition buildings.

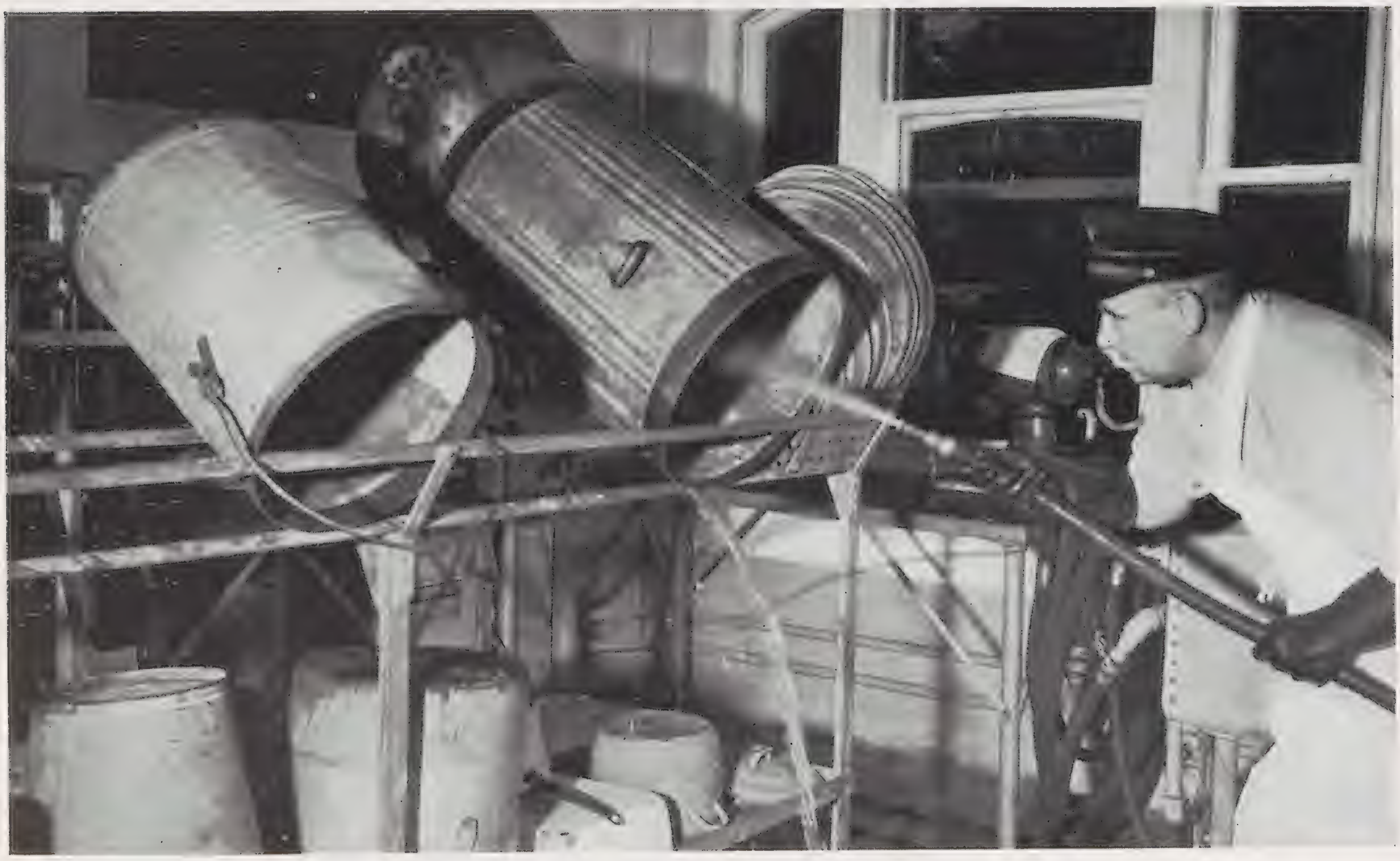
At this table the injuries of small animals are dressed, wounds are irrigated, enemas are given, and bathing and dipping performed. This basin is in the Surgery, in the corner opposite the operating table. The bench and basin can be thoroughly sterilized.

The small museum has a room of its own in the Hospital. Representative pathological conditions are illustrated by the specimens in jars. The collection of tissue slides is kept in this room, and here Dr. Herman does much of his routine examination.

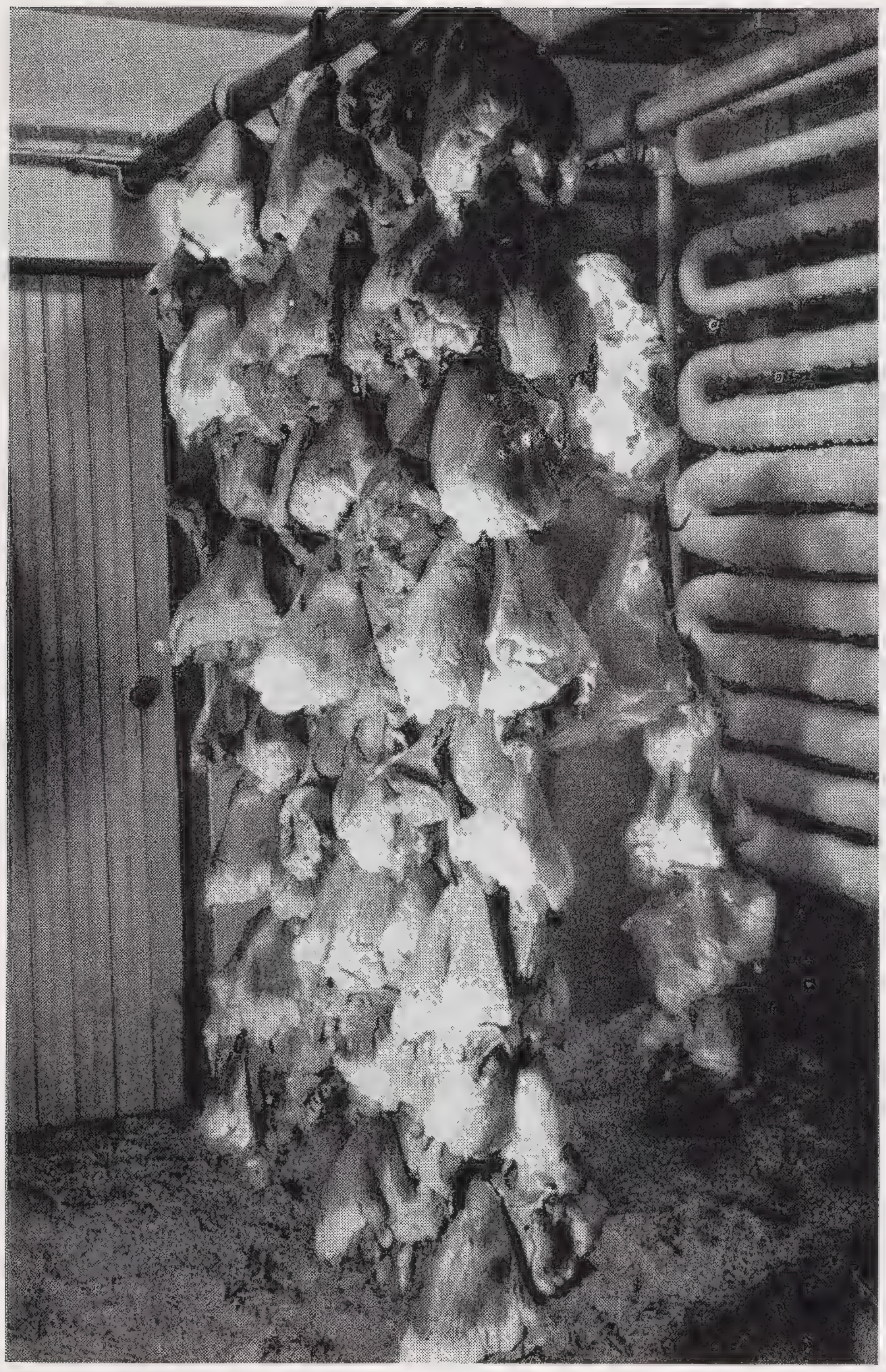
The bulkier supplies used in treating the animals are kept in this storeroom in the Hospital. Not showing in the picture is the barrel of fish-liver oil that is so important in maintaining the health of the animals. All exhibits get some of it daily.



A part of the Animal Kitchen is set aside for the cleaning and sterilizing of food containers. The Cook scrubs all his utensils daily with a 2 per cent. lye solution heated by steam—a necessary precaution against bacterial infections of the food.



After lye sterilization, it is extremely important to remove adherent lye from the food containers. Consequently they are arranged in a long metal rack and washed out thoroughly with scalding water. Walls and floor are also hosed down daily with steam.



Beef heart is an economical source of Vitamins A and B. We feed 800 lbs. weekly, in addition to liver, kidney and beef.

eases that cannot be demonstrated in the living animal—all these and many other causes of death continue to make work for the Veterinary staff. And when an animal dies, the Laboratory undertakes to discover why.

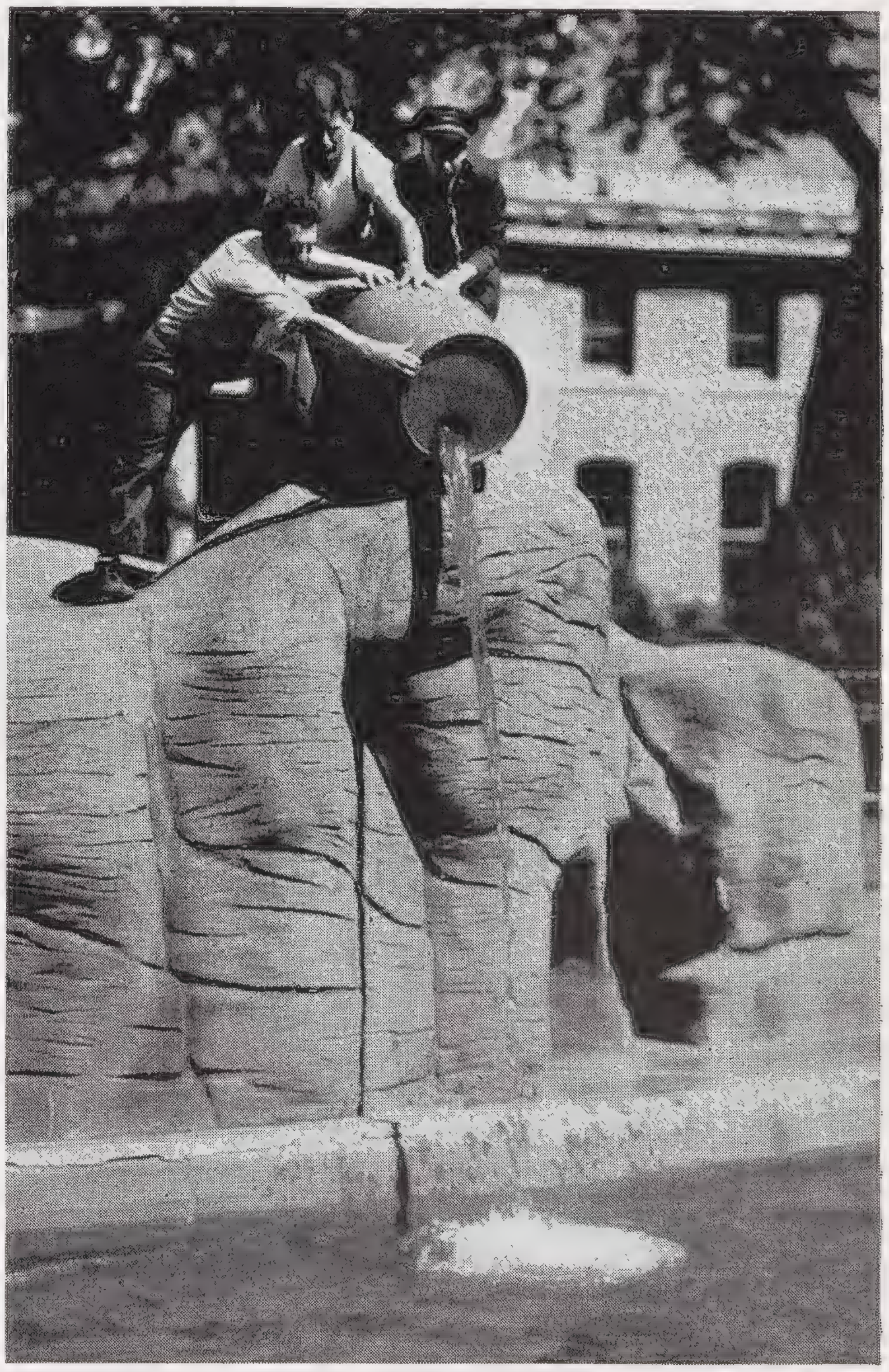
In a rear corner of the Hospital, in conjunction with the autopsy room, there are two large mechanical refrigerators. Cultured colonies of bacteria, sera, and other supplies requiring moderate cold are kept in one at a constant temperature of 40 degrees. In the other, where the cold is always 28 degrees, all dead animals are placed until they can be examined on the autopsy table.

During the past few months the staff of Mt. Sinai Hospital has been of invaluable assistance to the Zoological Park by sending relays of its graduate students in pathology to conduct the post-mortem examination of specimens. To the students it offers a fascinating opportunity for comparative study of diseases in animals and man—and to the Veterinary Department it is an unparalleled opportunity to have an important routine task performed skillfully and quickly.

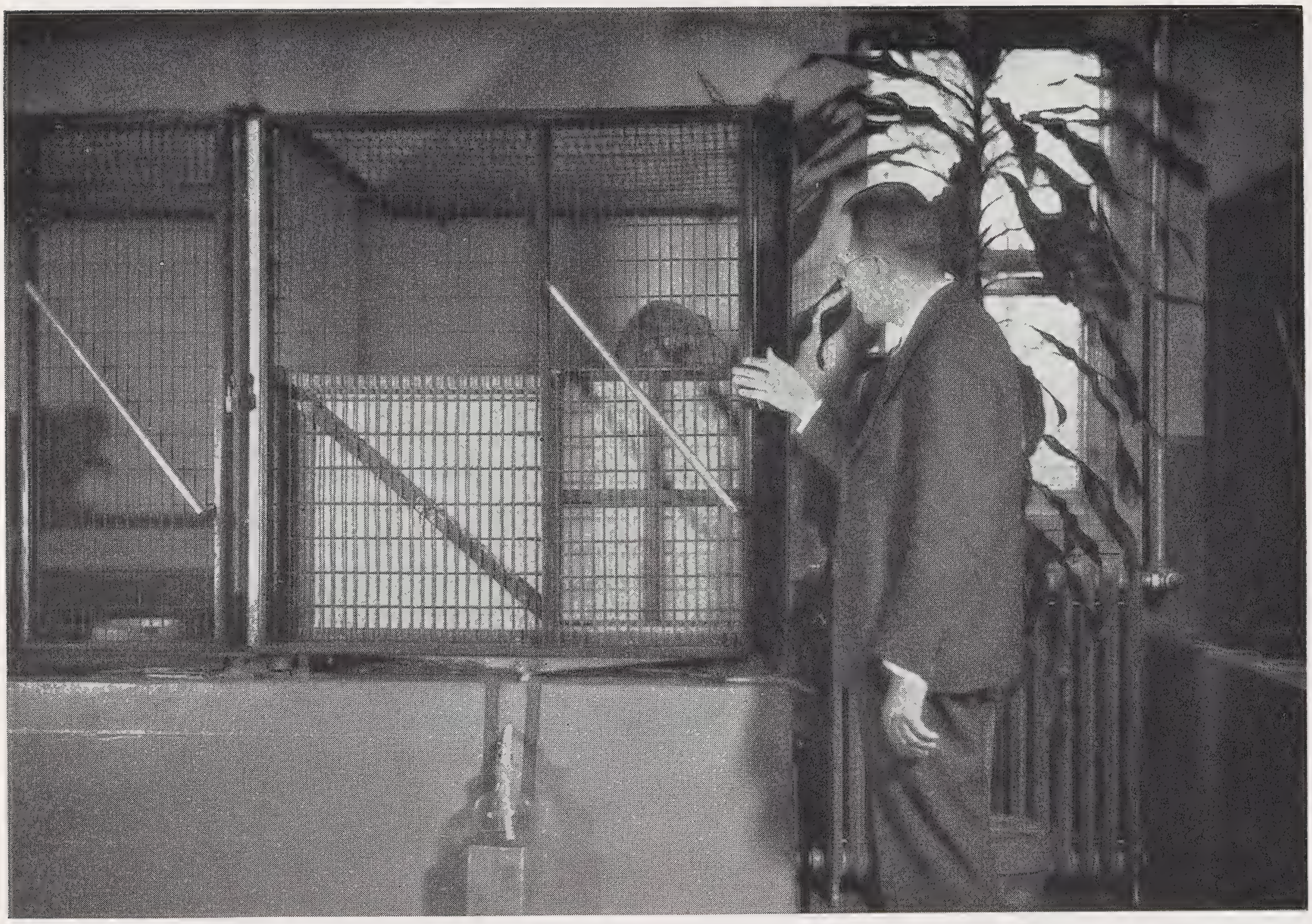
Every animal that dies in the Zoological Park is the subject of a detailed autopsy report. If bacterial infections are suspected, a minute drop of the material is spread on the gelatine bed of a test tube and the organisms are grown in an electric incubator until they can be identified by one of several techniques. Generally it is sufficient to identify the disease to know what measures must be taken to keep it from spreading.

Recently the Bird Department introduced a collection of Gouldian finches. One died, then another, and still another, within a few hours of each other.

The first specimen went promptly to the Laboratory, and in a few minutes the process



Copper sulphate (10 parts per million) is poured into the Sea Lion Pool in solution to kill algae and bacteria.



Research workers find the Hospital an ideal place to carry on physiological and disease investigations. Here is a special tank that was built for the collection of a 48-hour sample of urine from a California Sea Lion for a Cornell biochemist.

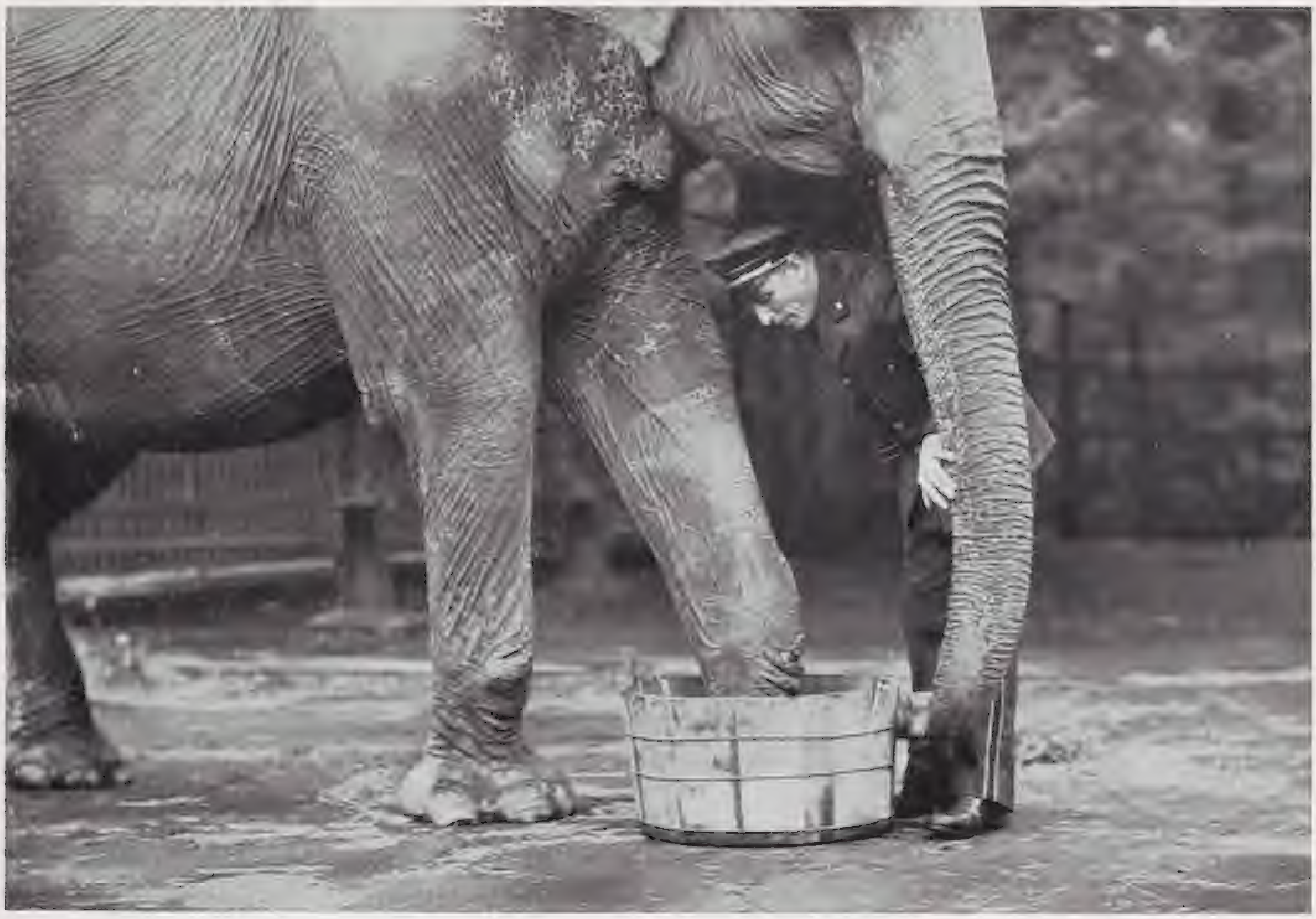
of growing cultures from the bird's body was under way. There is a definite, rather technical, routine for tracking down an unknown organism, and in this case it was followed through and the result was a demonstration of *Salmonella gallinarium* — the bacteria that causes bird typhoid. That happens to be a highly dangerous disease among birds, for it can sweep through in epidemic form and wipe out a whole collection.

Dr. Schroeder immediately telephoned Curator Crandall, who took the remaining Gouldian finches out of the cage and isolated them, and gave the cage a cleaning such as it had never had since it was new. As a result there was no more bird typhoid.

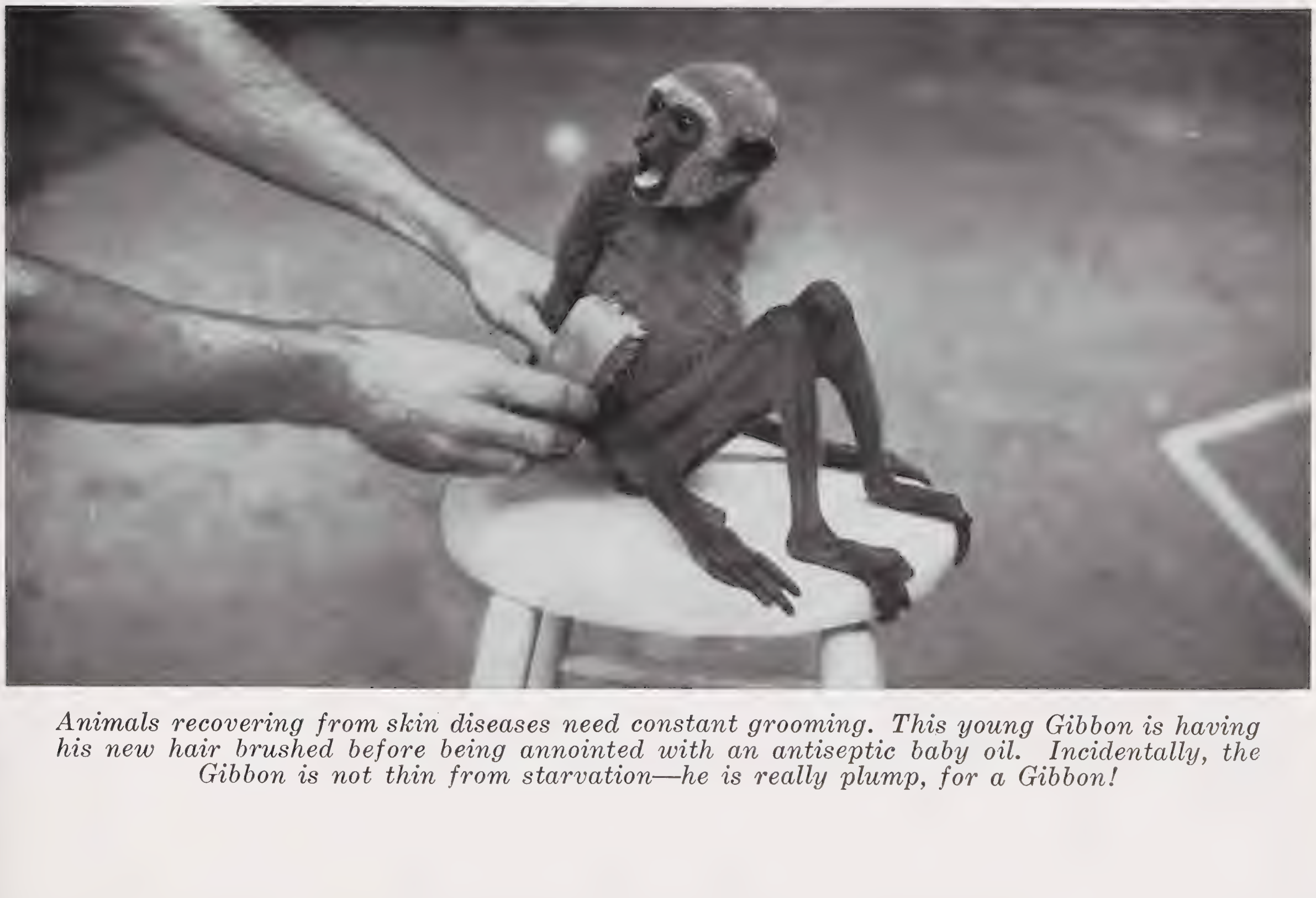
Research workers in animal and human diseases in many parts of the country have a standing order at the Hospital for organs or tissue. Tumors and cancerous growths excised from animals are sent to a pathologist in New York City, blood goes to a haematologist in Wisconsin, eyes to a specialist in Kansas, parasites to a parasitologist in California. Out of the autopsy room material is constantly going to the men who best know how to evaluate it and relate it to the great mass of human knowledge of disease.

Recently the Veterinary Department has had the services of Dr. Carlton Herman, a protozoologist from Johns Hopkins University, whose specialty is the diseases of birds. Under his direction the most minute investigations are being made of avian deaths in the Park, and data is being gathered that will be extremely important in maintaining the bird collection.

The Hospital has a fully-equipped Surgery, but it is seldom called upon. Emergencies that require the setting of a limb, an amputation, or the cleansing and bandaging of open wounds occur but rarely. Drastic surgery, even if it does not disfigure the animal for exhibition pur-



When Alice, the Indian elephant, developed a felon on her left forefoot, her keeper induced her to stand for long periods with her foot in a tub of hot copper sulphate to sterilize the foot. Then hot Epsom Salt solution eventually reduced the felon.



Animals recovering from skin diseases need constant grooming. This young Gibbon is having his new hair brushed before being annointed with an antiseptic baby oil. Incidentally, the Gibbon is not thin from starvation—he is really plump, for a Gibbon!

(Left) Young Chimpanzees are highly susceptible to the virus of the common cold. Even during recuperation it is important to prevent reinfection, and thus the Hospital attendant wears a mask when administering medicine.

(Below) This young Orang-utan is still in the Hospital, recovering from a tropical skin disease related to athlete's foot in man.

poses, is generally a greater shock to animals than to humans and Dr. Schroeder avoids it whenever possible.

Alice, the queen of the Park's elephants, was a possible surgical case recently. She developed an enormous felon on her left forefoot.

In a human patient, the normal procedure would have been to open the felon surgically and allow it to drain. In Alice's case it was possible to do that, but not very easy. She would have objected to the pain of the incision, if it were made without opiates, and the alternative would have been to load her heavily with drugs, put her to sleep, and then operate. That kind of treatment offers exciting and dramatic possibilities, but it is hazardous.

Instead, a big wooden tub was filled with a hot solution of copper sulphate, as hot as Alice would bear it, and she was induced to stand with her foot in the water. That cleaned the outside of her foot. Then the copper sulphate solution was replaced by a strong, hot solution of Epsom salts.

The treatment was continued intermittently for about four weeks. The Epsom salts gradually brought the felon to a head and it opened of its own accord.

Not on emergencies, on surgery and violent medication, but on patient, plodding, unexciting routine of sanitation, diet correction, diagnosis and research is the work of the Veterinary Department founded. It is not a dramatic story, but it has a happy ending—real knowledge of the how and why of animal health.

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All pictures not otherwise credited are from the photographic collection of the New York Zoological Park and the Aquarium.

Notes from the Zoological Park and the Aquarium

Tree Kangaroos

After being unrepresented for about five years, tree kangaroos are again to be found in our collection. Our present trio, secured the first week in July, are black tree kangaroos (*Macropus ursinus*), from New Guinea.

Tree kangaroos are distinctly arboreal and well fitted to spend most of their life in trees. Unlike the typical, plains inhabiting kangaroos, whose small fore-limbs are useless so far as locomotion is concerned, the fore-legs are strong and muscular, equipped with sharp, curved claws and almost as large as the hind limbs. The tail is long and slender.

While tree kangaroos are sometimes found on the ground, they are really at home in the trees. Since they are mainly nocturnal the day is spent asleep among the branches and most of their food, leaves and fruits, is secured at night. It is said that they can leap to the ground from a great height, thirty feet or more, without injuring themselves.

Our tree kangaroos are very tame, apparently hand reared. Optimistically in search of forthcoming tidbits they do not hesitate to climb all over anyone who enters their enclosure.—C.W.L.

Crested Guinea Fowl Chicks

Three chicks hatched on August 25 from five eggs laid by an Edouard's crested guinea fowl and are apparently the first of the kind hatched in the United States.

Single specimens of Edouard's crested guinea fowl have been exhibited in the bird collection before, but the first pair was received last winter as a gift from Prof. A. Ghigi of the University of Bologna, who obtained them while doing bird heredity work in Africa. The birds have feathery crests instead of the bony plates that are typical of other guinea fowls.

Although the parents are black with white spots, the chicks are brown and bear light stripes. This coloration will, of course, give way to the adult plumage later.

For the present the chicks are in the care of a bantam hen as a foster-mother, in the Pheasant's Aviary, and have not been put on exhibition.

Ellis Joseph

Ellis Joseph, the animal collector who brought a platypus, a koala, a turquoisine parrakeet, an Australian lungfish, the first blue birds of paradise, and many other animal rarities to the New York Zoological Park, died on September 16 at his home in New York City.

Before ill health forced his virtual retirement five years ago he was the world's foremost animal collector.

Specimens which he brought back from distant parts of the world were invariably in magnificent condition—a fact which speaks volumes for his knowledge of animal life, his ingenuity, and the hard work that he personally applied to the care of his collections.

Ellis Joseph was a man of forceful and winning personality and he had a reputation among zoological institutions for the utmost integrity.

Fishes from Africa

There are still several large areas quite inaccessible to the aquarist who has no field staff equipped for world-wide travel at his disposal. All of these are lands unexploited by the professional collectors of the tropical fish industry, for once they have established regular transportation lines it is relatively easy to arrange for the collection of some of the rarer or larger aquatic creatures which the industry often finds unprofitable to take. Thus, the Aquarium frequently receives both marine and fresh water species from southern Asia and the East Indies where a large German concern has established several bases for the trans-shipment of valuable finny cargoes.

But fishes from Africa are rare in American collections simply because no commercial dealers' lines to that continent are maintained. The 19 different species of African fishes in the Aquarium's tanks, while but a small fraction of the rich ichthyological fauna of the Dark Continent, represent a considerable expenditure of time, energy and ingenuity. Among these are such curiosities as the electric catfish, the lungfish, Kingsley's climbing perch and the butterfly fish, a sort of fresh water flying fish. Cichlids make up a large part of the fresh water piscatorial population of Africa, and a great many of them practice the amazing habit of oral incubation—that is, they carry their eggs about in their mouths until hatching. In some species the male, in others the female, and in still others both sexes incubate the eggs. The Aquarium has three species of these so-called "mouth-breeders", belonging to the genera *Tilapia* and *Haplochromis*, on exhibition.

One of the best sources of African specimens has been the unfailing generosity of the London Aquarium. On August 29 a shipment of six species of fish from West Africa arrived in New York from that institution via the *American Banker* of the United States Lines. The prize of the collection is a lungfish, *Protopterus annectens,* 31 inches long and 4 inches in greatest diameter. This beautiful specimen is the largest lungfish ever to come into the Aquarium. A ball fish, *Tetraodon testudineus,* from the Red Sea was also included. This fish can inflate itself like the puffer locally abundant to which it is related. Unlike the puffer it has soft, smooth skin and is more brightly colored.—J. W. A.

J. E. Ward, the author of "The Curious Australian Bee-eaters," is the Australian naturalist who accompanied Curator Crandall into New Guinea in 1928 to collect birds of paradise.

The giant anteater mother and baby, pictured on the cover of the *Bulletin,* are among the newest additions to the Park's collections. The baby was born during shipment of the mother to the Zoological Park from South America. Although quite capable of locomotion by itself, it frequently climbs onto its mother's back, holds onto the long hair on her sides, and rides while she explores her cage.

A small colony of parasol ants (*Atta* sp.) has been placed on exhibition in the Reptile House. The ants were brought back from Trinidad in mid-September by Dr. Ditmars, who obtained them during a vacation cruise.

Their common name refers to their parasol-like method of carrying bits of leaves which they cut out of vegetation and carry back to their underground nest.

A specimen of the curious West Indian Ribbonfish (*Eques lanceolatus*) is a recent accession at the Aquarium. It is, apparently, the first time it has been seen in the Aquarium's collection.

The fish is about 4 inches long, but fully grown specimens reach a length of 10 inches. It is silvery yellow with dark stripes—one horizontal and two vertical. The Ribbonfish is a relative of the less spectacularly marked Cubbyu (*Eques acuminatus*) and of the Weakfish.

PUBLICATIONS OF INTEREST

FIELD BOOK OF FRESH-WATER FISHES OF NORTH AMERICA NORTH OF MEXICO. By Ray Schrenkeisen (late Associate Editor of *Field and Stream*). Edited by J. T. Nichols and F. R. LaMonte (American Museum of Natural History). G. P. Putnam's Sons. 312 pages. 1 colored plate and numerous line cuts.

The ever-growing list of Putnam's "Field Books" has come to its twenty-first volume in this guide to the identification of North American fresh-water fishes. Judging by the queries continually received at the Aquarium, it should fill a long-felt want and one of considerable magnitude. The data on which the book was based had been gathered by Mr. Ray Schrenkeisen only to be left unready for publication by his untimely and unexpected death. His materials, edited and arranged by Mr. J. T. Nichols and Miss F. R. LaMonte after the delay to be expected in such cases, finally have been placed before the public and undoubtedly will be of great service to all those who may have occasion to attempt the identification of American fresh-water fishes.

The treatment is generally the same as in the rest of the series. Formal keys, however, so frequently to be found in such books, have been omitted entirely. In their place diagnoses of the principal forms in each group have been given, the reader being guided to the general section by broad descriptions of families and line sketches of characteristic types. The many closely similar species and subspecies related to any one form may be identified by reference to a section called "Related Forms" to be found under the more fully described primary species. Considering the confused state of these finer divisions of American fresh-water fishes and the naturally slight interest in them that an amateur ichthyologist could have, this is perhaps as good a way as any to handle the situation at present, in a book of this type. As the editors say in their introduction, the intention is to make it possible to ". . . name correctly any of our fresh-water fishes of importance . . ." that come to the reader's attention. With such expressed intent, it would be merely captious to criticize such technical and specific omissions as may occur to the professional ichthyologist. Matters of nomenclature and terminology have been reduced to a minimum and this minimum is adequately explained by the text, a figure, and a glossary.

Examination of this book called to mind forcibly that young people of today are much better provided with instructive literature than they were in the days of my own youth. Between twenty-five and thirty years ago, in the early 'teens, I wanted and needed just such a book as this to satisfy a large appetite of curiosity concerning the smallish creek fishes that were then available to me. At that time, the only pertinent books obtainable in the local library were Jordan and Evermann's four-volume treatise on North American fishes, and Fowler's one volume on the fishes of New Jersey. Both were thoroughly technical and hardly suitable fare for the digestion of an adolescent. The hours spent trying to ferret out meanings and definitions, while probably not exactly wasted, could, no doubt, have been put to a much better use. Now, after all these years, here is just the kind of a book that a novice, young or old, could manage without becoming lost in a morass of technicalities.

An unusual feature for such a book is that in addition to the current, and often transient, scientific name, others are also given together with a large variety of common and local names, which in some species run to a considerable number. For example, the small-mouth black bass is also called by no less than thirty-one other names, while for the large-mouth there are forty-five additional. This feature alone makes for a useful field book, especially when one is away from his own particular bailiwick. Furthermore, in the 26-page index, all these are listed, so that one may quickly ascertain if any name picked up in conversation with some local naturalist applies to more than one kind of fish. —C. M. BREDER, JR.

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—PAUL ENGLE, *Cedar Rapids Gazette*

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LI, No. 6 November-December, 1938

BULLETIN

NEW YORK ZOOLOGICAL SOCIETY

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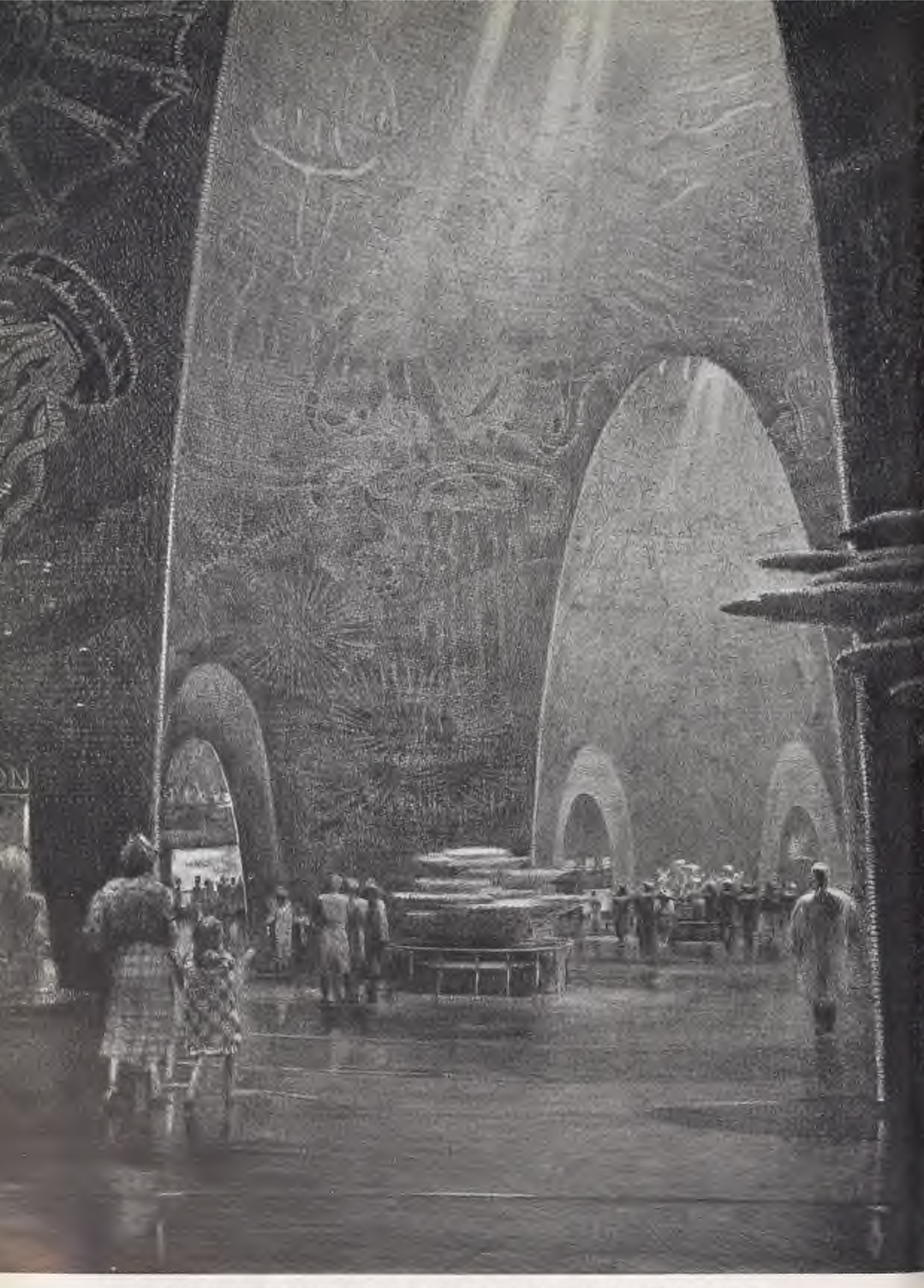
WERE we to withdraw ourselves to a far distance from this earth, we would look down upon a sphere largely covered by water. Were we, further, to philosophize somewhat regarding life upon this earth, there might occur to us a fresh conception of the importance and relationship of these great bodies of water to the human race, and our minds would cast back through countless ages to that time when the only living forms existed along the littoral dividing the great oceans from the continents. Then, by a titanic time-stride back to the present, we might think upon the ways of civilized man, his ceaseless activities and strivings, and divide his existence into two areas—one, his struggle to live, the other his mental and creative resources—and, pondering on this, we might see more clearly why modern man desires so passionately to pull aside the veil which hides from his view the eternal story and fascination of the universe of which he is but a part.

At such a moment, also, we might better realize why a building designed to show to modern man the life and forms that exist in the waters of the world, from which originally all life forms came, is of significance in the lives of people today. And we then might more clearly understand the immense popularity of our present Aquarium, antiquated though it is —an old fort patched up for its present purposes—to which annually more than 2,000,000 persons from New York, neighboring cities, the West, in fact from all over the world, come for an inadequate glimpse of the wonders of life in the waters.

With the above general conceptions in mind, is it not apparent why this Society so ardently hopes that by one means or another a new Aquarium, studies of which are reported in the following pages, may come into being?



PROPOSED ENTRANCE HALL OF THE NEW YORK AQUARIUM OF THE FUTURE

BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

Published by the New York Zoological Society

Vol. XLI November-December, 1938 No. 6

The New York Aquarium of the Future

A New Concept of Aquarium Design and Function is Offered for the Inspection of the New York Zoological Society

Charles M. Breder, Jr.
Acting Director, New York Aquarium

An invitation to build on paper a new Aquarium for New York City is one that is calculated to make any Aquarium man feel as if he had fallen into one of his own cold water tanks. But just such an invitation has been extended to me by the Trustees of the Zoological Society and I take advantage of it here by sketching in general terms a new and practicable Aquarium that would, I think, place our institution far in the lead as an interpreter of the wonders and mysteries of aquatic life.

For a good many years we have watched visitors pour through our doors, and have listened to their questions and noted what held their attention. We know that some of them came hoping to learn, some simply to be amused, and some to stare in mild wonder at the queer creatures we displayed. Under the impact of daily experience with Aquarium visitors I have reached certain definite conclusions about a new kind of Aquarium that will not be determined by rule of thumb ideas but will be moulded by a rational presentation of the subject matter best calculated to serve the interests of the people who use it.

I know only too well that we are not meeting these needs and interests now. It has never been a secret that the present Aquarium is not well adapted to its purpose. Even by the standards of aquarium practice that obtained forty years ago when it was created, it is lacking in many essentials simply because it had to be fitted willy-nilly into the confines of a building that was constructed originally as a fort. Our operating and exhibition handicaps have been pointed out by Dr. Townsend many times in the *Annual Reports*.

This article will outline briefly what I think the functions of a modern Aquarium should be, and in general how we can provide for them in a building specifically designed for that purpose. These remarks, then, may serve to clear the ground in preparation for a later article in which will be discussed working details that would set our institution apart from every other public aquarium that has ever been conceived.

At the present time studies for a new Aquarium are being drawn by the architectural firm of Harrison and Fouilhoux. The elevations, floor plans, and numerous detailed cross-sections are proceeding satisfactorily but this must, of necessity, be a slow and careful business and it seems better to reserve those plans for subsequent presentation. In the meantime, as evidence of the breadth of the architects' conception, we are submitting the drawing that forms the frontispiece to this number of the *Bulletin*—a sketch of the entrance hall to the New York Aquarium of the future.

As I see it, the business of an Aquarium is to exhibit a judicious selection of the aquatic life of the world *presented as an integrated whole*. Essentially this means real explanation and interpretation of a satisfactory exhibition.

In a discussion of the content of this article with a layman recently, he remarked that this central core of my plan was obvious, non-controversial and not in need of preliminary statement. It had seemed to me, too, that it was obvious, but it is equally obvious that with a single exception—the ingenious venture called "Marineland," near St. Augustine, Florida—no Aquarium has made any effective effort to put any really new idea into operation. Within recent years there has been new life stirring in museums and zoological parks, so that the modern institutions little resemble those of thirty or even twenty years ago. Public aquaria, on the other hand, have shown no radical changes in concept. Their basic pattern was already set at the beginning of this century. One and all, they consist of a series of glass windows in a virtually unbroken line, with all the eyestrain and "visitor fatigue" that other institutions years ago learned to overcome. Their labeling of exhibits is still primitive and consists of little more than a placard stating: "This is a Seahorse—look at it and pass on to the next window." Rarely is an effort made to explain the How and the Why of the exhibit, and if it is made, the explanation might usually be read more conveniently in a book.

Worst of all our faults is the fact that there is no correlation between one exhibit and another —no natural sequence to lead from one to another so that, at the end, the ordinarily observant visitor has insensibly and easily gained a survey picture of aquatic biology. And this we must give him if we are ever to satisfy much more than idle curiosity. While other types of institutions are becoming essentially "museums of ideas" we are still "museums of objects."

The physical proportions and arrangement of an Aquarium that would serve this purpose are, as has been indicated above, a matter of adjustment between practicality and harmonious architecture. Basically the building would consist of an appropriately connected series of halls designed for specific purposes. Provision would be made for each of the following items:

A display of tropical, temperate and polar marine life.

A display of tropical, temperate and polar fresh-water life.

A display and demonstration of fish-cultural methods.

A display of microscopic and near-microscopic aquatic life.

A display of biological demonstrations. These would include the senses of aquatic animals, the behavior of aquatic animals, the relation of aquatic animals to their environment, the evolution and development of aquatic animals, and the relation of aquatic animals to Man.

A display by automatic motion picture projection of details that could not be shown by demonstration.

A Children's Hall with special juvenile exhibits.

A Lecture Hall for special events.

With these eight major provisions, every public function that the Aquarium might be called upon for could be provided. In the working out of such a program—which, it will be observed, is virtually an interrelated and integrated visual course in aquatic biology—certain important departures are made from current aquarium practices. These concern such items as the separation of glass-fronted aquaria by panels on which explanatory diagrams and illustrations are to be shown, extreme flexibility of exhibits through the use of portable tanks and movable panels, provision for viewing certain of the larger aquaria from above as well as the side, extensive use of habitat planning and aquatic vegetation, improved directional lighting (which has already been tried experimentally and found satisfactory), and so on.

These items are matters of working detail which will be more fully explained in a later article when a diagrammatic cross-section of the Aquarium is available. From the visitor's point of view they are all of the utmost importance and they deserve the full attention that will be given them at that time.

The entrance hall pictured at the beginning of this article acts as a reservoir for the large crowds that we may expect and as an orientation chamber where the visitor may get a clear understanding of the scheme followed in the exhibition halls.

Now, taking up these halls one by one, in the order planned for the visitor to view them, their main features may be summarized as follows:

1. Hall of Fresh-water Life

On entering this hall the visitor would immediately be confronted by Arctic or cold water forms. Here the attractive trouts, a primitive group, would be displayed with explanatory matter showing their ranges, manner of life, and so on. One large tank that could be viewed from the side and above would contain a small waterfall and a fish ladder in operation. This would demonstrate habitat requirements and show the methods employed in the great upstream migrations of these fishes. With a suitable division the visitor would be lead on to the fishes of the temperate zone: basses, sunfish, catfish, carp, perch, gars and many other suggesting the increase in number of species as one moves southward. One very large aquaria to be viewed from above and below could be used to represent a local pond. This would have a shore line representing a pond border and the whole display could follow seasonal variations of the New York region. Specimens living in this aquarium would be those typical of such a local pond: in winter, ice would form on the surface and the hibernating fish could be seen beneath its surface; in the spring, frogs and toads would spawn at its edges while the fish were still quiescent; later, perch would spawn, to be succeeded by the spawning of bass and sunfish, and so on through the season.

Further on this section would give way to the tropical exhibits. Here the enormous variety of tropical fish, ranging from the giants of the Amazon to the small species suited to home aquaria would find a place. Similar in plan to the seasonal display of the temperate-zone fishes, a huge tank could show a selected Amazon habitat with fully and semi-aquatic forms of as many kinds as could be induced to live together. Alligators and crocodiles, giant fresh-water turtles and the tiny fishes to be found with them could be housed here. Another such tank, omitting the large crocodilians and the tiny fishes but holding creatures of intermediate size, could be equally effectively employed. These medium-sized species are not typically found at peace either with the large creatures, for which they are natural food, nor with the very little fishes, upon which they feed. This relationship, explained and exemplified, would contribute significantly to the visitors' comprehension of the struggle for existence.

2. Hall of Marine Life

This hall would be essentially similar in plan to the Hall of Fresh-water Life but is designed on a somewhat grander scale suggestive of the greater biological differentiation in marine habitats. In addition to showing the variations in aquatic life in seas ranging from the polar regions to the equatorial, it would contain brackish-water aquaria to indicate the cross-merging with fresh water. Tidal aquaria could house displays of the intertidal invertebrates that cannot be kept satisfactorily without such changes.

The very large aquaria in this hall, to be viewed both from above and the side, could contain porpoises, sea lions, seals or penguins. The underwater locomotion of these animals, as viewed from the side, is a sight never to be forgotten. Sharks or tarpon could also be displayed to excellent effect in such an arrangement.

These two halls, of Fresh-water and Marine Life, as now planned, would actually contain more footage of display space than the whole of the present New York Aquarium, and in addition would present the exhibits in a far more effective manner.

3. Demonstration Hall

Demonstrations of various biological specializations and the dynamics of aquatic existence would be grouped in a single hall. These include demonstrations of the senses and behavior of aquatic animals and their relation to environment, and such special features as the inflation of puffers, the perambulating methods of various walking fish, shooting by the archer fish, the electrical discharge of certain fishes, and so on. By means of diagrams and charts and pictures the teachings of this hall can be linked with the exhibits elsewhere and with such broad subjects as development, migration and evolution. Certain features not repeatable at will could be presented by means of automatic motion picture projection—the nesting habits of fishes, whales at sea, and the like. It should be emphasized that the displays in this hall are not museum material but that they would be essentially dynamic and based to a very large extent on living material.

4. Economic Hall

A model display of fish-cultural methods would be the central feature of this hall, with additional material stressing the relationship of aquatic life to Man. This would include principally the economics of the fisheries and indidate that in addition to the biological interests of the other halls, there is a direct, workaday, reciprocal relationship between aquatic life and human life. Here, again, automatically projected motion pictures could well supplement the display. The fish-cultural activities would actually produce fishes for planting in local waters, a function now carried on to only a slight extent.

5. Children's Hall

Finally there would be a Children's Hall specially designed to present biological knowledge on the level of a child's mind. Here the exhibits, the illustrative material and the demonstrations would necessarily be of the most elementary type, but there is no reason to think that they would appeal only to children. Indeed, we have found that many adults are lacking in a basic, fundamental knowledge of aquatic life and would profit greatly by a beginners' course such as this hall would offer. The hall might also contain instructive displays on the establishment of a home aquarium, the effects of various types of aquaria on the specimens inhabiting them and drawings, pictures and objects graphically answering typical child questions. Adjacent to the Children's Hall there would be a lunchroom for school groups and nearby, but separate, a restaurant for adult visitors. Both would be so arranged as to overlook New York Harbor.

6. Lecture Hall

This would be opened only to special groups for lectures to classes or for the meeting of scientific societies and similar events.

By means of these five public halls and a lecture hall for special purposes it is clear that the proposed Aquarium would render an outstanding educational service to New York City. It seems to me obvious, and I need not take space here to labor the point, that the arrangement, demonstrations and graphic illustrative material here projected offer something concrete for all mental age groups. As a single example, the Halls of Marine and Fresh-water Life would certainly offer something to every type of visitor. A really dull fellow would carry away an impression of "a swell bunch of funny fishes." The average visitor might see a carefully arranged exhibit from which he would feel that he had "learned a lot." A superior lay visitor might be impressed by careful planning that "enlightens one on the distribution of aquatic life and its relationship to its environment." A technical visitor would undoubtedly approve—and would want to argue about some debatable point. In any event, it seems to me that these halls would appeal to everyone and give each person all the knowledge he was capable of carrying away.

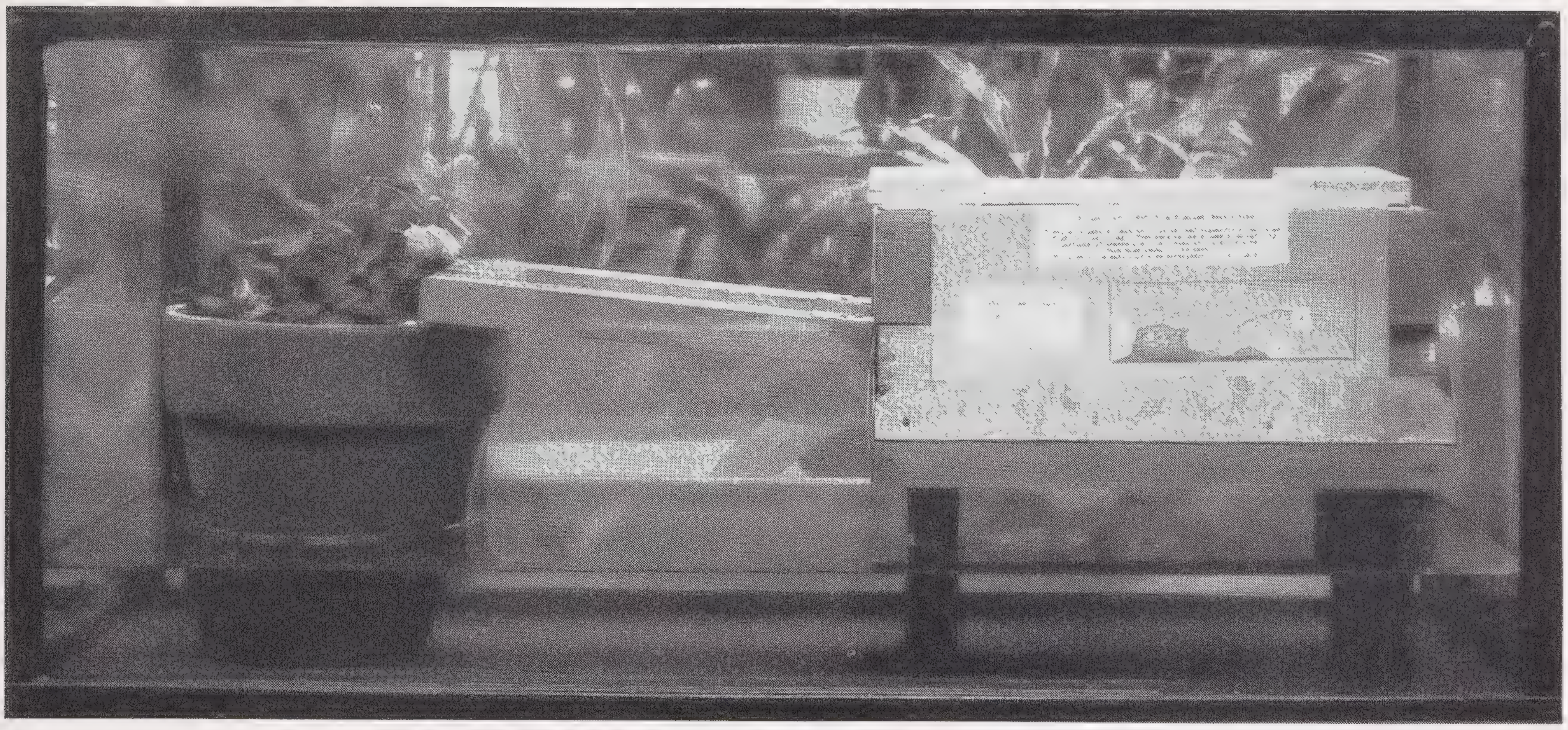
The primarily educational activity of such an institution can only be supported and maintained by continual study and research. With the exception of our own present Aquarium, scientific research is almost completely lacking in public aquaria in this country. While our scientific activity needs no defense, it nevertheless has always been a stepchild, starved by lack of funds and time. What could be done in this direction, with a modicum of encouragement, would undoubtedly be amazing.

Within recent years and despite great handicaps, the New York Aquarium has worked out a satisfactory but not too rigid scheme of research. This should and could easily be developed as a long-range research program that would have a most important bearing on the operating details and further development of the institution.

In the architectural studies being drawn up, there is, of course full and adequate provision for all the various supporting departments that a satisfactory aquarium needs—shops, heating plant, refrigeration, laboratories, library, storage and so forth. In short all integrated technical needs of the proposed operation to render an important educational service are being, at this time woven into the necessarily elaborate plans.

* * *

The ideas I have held up here for the inspection of the Members of the New York Zoological Society are workable, practical and possible. Whether they are desirable it is for others to decide. I have been dreaming of a new Aquarium for years, and now I am taking my dream to the window and asking you to look at it in full daylight.



The colony of Parasol Ants, in the wooden box inside a tank, is surrounded by water to guard against escape of the ants. A wooden runway leads to the pot of leaves and flowers.

A Colony of Parasol Ants

An Artificial Home in the Reptile House Reproduces in Miniature Their Habitat in Trinidad

Raymond L. Ditmars

DURING various tropical trips with studies of reptiles in mind, my contacts have been as frequently with entomologists as with scientists of other branches. The investigations of these men are of great importance in the warm countries where insect life teems in such variety, some markedly hazardous to human health or economic production. Thus the field work of the entomologists is broad, and their cordial advice has led me into many interesting places which I would not have discovered otherwise.

It was upon the advice of a noted entomologist and most esteemed friend, the late Professor F. W. Urich, of Port-of-Spain, Trinidad, that I sought and finally found the opportunity to transport and study the nest of the strangely fascinating Parasol Ant, *Atta cephalotes.* I hoped to maintain a colony of these ants under artificial conditions, and to create a novel exhibit for the Zoological Park.

The Parasol Ant, or Bachac Ant as it is known on the island of Trinidad, has a range that has been reported from tropical Mexico to Bolivia and the basin of the Amazon. It appears to be the sole species of *Atta* in the Orinico Delta, Venezuela, but in British Guiana it occurs with another species in the Essequibo basin. It is distinctly a forest ant and no forests are too dense or darkly shaded for it. This does not mean, however, that its leaf-carrying processions do not extend into open or even sunny places. Species of the genus *Atta* receive the common name of Parasol Ants from their habit of carrying relatively large fragments of freshly-cut green leaves over their heads as they transport them to their nests. The pieces of leaves are carried with the edges directed vertically. One of the strangest sights in jungle-forest is a procession of these cutters or carriers, which from a large and very populous nest may extend a fair fraction of a mile. The effect on first view is of an interminably long and narrow stream of small, bright green leaves in slow but constant progress. The line may

Photo Department of Tropical Research

The mound of a Parasol Ant nest in the jungle near Para, Brazil. From such a large nest as this trails radiate through the forest and over these the ants carry cuttings of leaves to the underground fungus garden.

be in sight for a hundred yards or more as it emerges from a brushy spot and then disappears into another. The line appears again and over long stretches where bits of forest débris have been removed to give it unobstructed progress.

One has but to study this procession at close range to gain a picture of systematic industry, of machine-like, prodigious labor, that is certainly one of the most fascinating of insect manifestations.

The inference might be that these leaf-fragments form the food of the ants, that this constant storage of greenery means replenishment of a growing larder. It is true that the species of *Atta* belong to a group known as agricultural ants, but the leaves are not consumed in the form brought in by the workers. These ants are fungus or mushroom growers. Ages before Man began intensive study of mushroom growing, the Parasol Ant had mastered such production in providing a type of high and invariable nourishment for its colonies. Possibly the term mushroom-growing is not literally correct and does not give enough credit to these systematic insect workers, which seek a specific fungus—a *Phycomycetes*—and carry the spores to their subterranean domed chambers, where they create fungus beds with the compacted leaf fragments as the growing medium. These beds are of cake-like form, sometimes very round and symmetrical. With a young colony the cake, or community larder, may be no larger than a teacup. With a large and long-established colony there may be several chambers, an intricate underground apartment covering an area of fifty feet or more and containing several of the fungus mounds or gardens. These rise in a cellular mass, are usually pale gray in hue, of fair weight in pounds and fully the size of a large melon. The colony is completely dependent upon this food and its immature or brood members are kept in the fungus garden in a series of honeycombed cells within the mass of fungus and its substrata. The colony consists of members of various sizes, the largest member, as with other types of ant colonies, being the queen. She dominates, as production

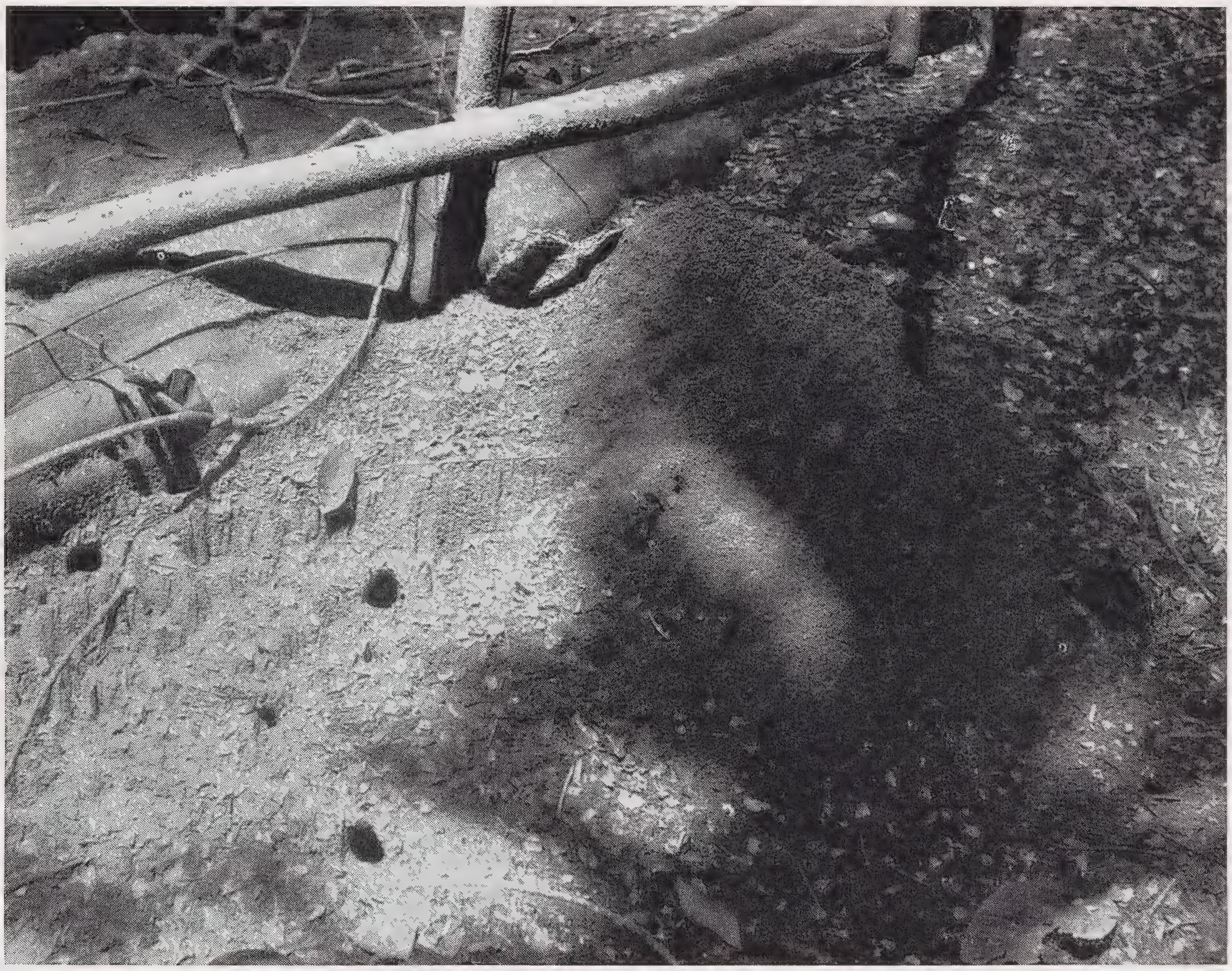


Photo Department of Tropical Research

A closer view of the Parasol Ant nest on the opposite page, showing the holes that give the ants access to their garden. In large colonies there may be several chambers in which the fungus food is cultivated.

of eggs depend upon her. If anything happens to the queen, the colony's ambition dwindles.

The complex life of a Parasol Ant colony is best understood by taking up the very start of a nest and noting its development. At periodical times, usually the wet season, there is a great activity within a well-established colony. A large number of prospective queens prepare to issue from the nest in nuptial flight. Both they and the male consorts have grown gauzy wings. They have lived an idle life, fed and groomed by their dwarfed and hard working sisters. It is by special care and feeding that they have attained their superiority over the others and the possibility of brief emancipation from life in the underground chambers. Breaking through to the open air they issue in a dense cloud, exhilarated by the possibility and feeling of flight. But dangers surround them everywhere. The flight has been made toward twilight or in early evening. Insectivorous bats are on the wing and snap them up; insectivorous birds become alert to easy feeding; as some pause to rest they are devoured by lizards, frogs and toads. But a small percentage remain to start new colonies, and even the beginning of such a project, by a single, fertilized queen, is attended with uncertainties.

To clarify the picture, it is best to follow the adventures of a single queen. She has met her consort in the air and they have mated. The male whirls off to pass out of her life, in fact, quickly to die.

The queen scales downward from her flight. Forest odors, possibly very specific odors indicating favorable soil, lure her to earth to seek a spot where alone and unaided she will seek to start a new colony. A small hole seems most favorable, at the root of some plant or under a stone. Here she prepares to take up her burden and she starts by tearing off her wings.

Before the dissemination flight the winged females have acquired a pellet of spores from the fungus garden of the parental nest. This is carried in a pouch back of the jaws. The lonely queen plants these spores in a damp matrix which she carefully tends, and as this miniature fungus garden grows and flourishes she lays eggs in its cellular parts. As they hatch she watches and feeds the delicate little white larvae until they have transformed to ants of several sizes, but all much inferior to that of the queen. In fact, in comparison they might seem to be of quite unrelated species. The queen's lonely vigil and hard work are over. Her progeny now systematically take over the labors of the colony and rapid expansion begins.

The late R. R. Mole of Port-of-Spain, Trinidad, to whom I have been indebted for many interesting specimens from the tropics, has written about the growth of a Parasol Ant colony: "The bigger ants sallied forth day after day, night after night, and sought young cocoa leaves or rose blooms, and the petals of other flowers. These they dexterously cut into roughly circular shape and carried parasol-like to the nest. The little sisters who had not left the nest took the leaves and worked them up into little balls, and arranged them in orderly fashion in a space which they had prepared underground. Upon these they planted more fungus spores. The very tiny ants made the eggs and the other young ones their special care. They fed the youngsters as they emerged and the whole community worked hard to keep pace with the ever increasing wants of the family. The nurses went on nursing, the leaf cutters went on leaf-cutting, the ants that stayed at home made the leaves into balls and the gardeners arranged them and planted the fungus on them. It was a growing community, and every day there was an increasing army of leaf-cutters, gardeners and nurses. The foraging procession became longer and more numerous and as the foragers came home, each with a leafy umbrella overhead, the effect was very pretty, but it was intensely irritating to the human agriculturists and the gardeners.

"Hitherto the nest had been defenceless against all but the most ordinary foes, although the little leaf cutters were quite brave fighters. But they were not strong enough, nor had they the sufficiently powerful mandibles to make much impression upon any but the most ordinary enemies of the community. There was much more food now, and so the busy nurses began to make preparations for raising and maintaining an army. Rations were increased to some of their charges and these consequently developed into very much larger insects, soldier ants with big heads and large and powerful jaws. Thus a standing army was created. None of the ants in the community can see very well, and the soldiers have the weakest vision of all. Perhaps that is the reason they are so brave, for like the blind-folded gladiators of the Roman arena, when danger threatens they rush to the spot, bury their huge, scissor-scythe-like mandibles in the enemy and rather than let go, allow their bodies to be torn from their heads."

This was the type of ant I had seen so often in the tropics; many times I had sat and rested on a fallen tree while the procession of leaves went by, a parade that faded to a dim green line several hundred feet away. I knew the general history of *Atta* and figured that such a procession, with background and descriptive label, would be of interest in the Reptile House of the Zoological Park. That particular building was chosen because its temperature is uniformly high and the abundance of palms and other plants produces a greenhouse atmosphere approaching tropical conditions.

It was shortly before the start of a brief holiday trip to Trinidad the past summer that I studied the possibility of successfully transporting a young colony of *Atta cephalotes,* a queen and the first types of workers to be developed in a nest in which the soldier types had not yet been reared. I did not relish chaperoning and caring for a colony containing the soldier types of ants. I remembered some experiences with the latter while getting a bit too inquisitive about *Atta* parades in Panama. The soldiers can run as fast as a ground spider, come at one without hesitation, and their strong jaws will draw blood. Years ago a nest was brought to New York and those ants gave me as much trouble as a cageful of monkeys.

Before leaving for Trinidad it was necessary to seek permission from the Bureau of Entomology and Plant Quarantine, at Washington, to import living tropical insects. The request was accompanied by full details as to the character of the insects, where they would be sought, how they would be transported and the exact conditions under which they would be exhibited. The permission was granted on the understanding that specifications in my letter would be precisely followed.

A flat case was prepared, this being approximately two feet long and a foot and a half wide.

It was four inches high and had a sliding glass top and a glass bottom, making it warp-proof. Ventilation was through side ports of fine brass screen.

The nest was dug up a short distance inside some jungly forest growth of uneven surface, where bank-like slopes drained the heavy tropical rains and furnished an ideal site for a nest. Mr. Ludolph Wehekind had located this particular nest. The shortness of its leaf-carrying procession indicated a young and compact colony, with few or no soldiers as yet developed to attack during our digging and thus hinder careful removal of the fungus garden, the queen and workers. The immature colony was in a hollow or domed chamber less than a foot in diameter and but a few inches high. Close to the center was the fungus garden, looking like a small and very coarse sponge of pale grayish hue. Ants of three sizes were tending it.

The fungus garden, or cellular cake, as it also might be called, was carefully placed in my transportation case, which had been divided into three "rooms" or compartments. The fungus garden went into one; in another was placed a test tube of water with protruding wick to provide moisture by evaporation; while the third compartment was fitted with earth from the bed and walls of the nest. The compartments had small, arched, communicating passages. I did not see the queen, as she appeared to be in a special little chamber of the substratum of the garden.

Photo D.T.R.

Leaf-cutting, or Parasol, ants carrying fragments of leaves down the trunk of a tree to be taken to their distant nest.

I made no attempt to provide any leaves for about twenty-four hours, as there was considerable to do in getting aboard the northbound steamer, which was to take about ten days in reaching New York. But I sent aboard branches of rose bushes, mimosa and acacia, the latter appearing to be the leaves which the ants were carrying to their nest before it was dug up.

The case was placed in my cabin and when I looked at it a day later the ants had been busy. They had been carrying soil into the chamber containing the fungus garden, working it into pellets and building a rim about the fungus. This work clearly indicated that they intended to protect it with a dome-like covering. This was accomplished within a few days, and since there were comparatively few ants, the amount of labor they accomplished was surprising. I estimated that within four days they had transported about half a pound of soil, and so I went ashore on one of the islands for more. They moved this, too, before I reached New York.

When I started to place leaves in the compartment containing the water bottle, the slight disturbance of sliding the glass back for an inch or so brought the leaf-cutters rushing out. Their actions were very different from their plodding gait as I had seen them carrying burdens to their nest. They could run at considerable speed, and they attacked and bit. Noting the tenacity of their hold, I was glad that the colony had not as yet reared any of the big-jawed soldiers. Not wishing to lose any of the ants, nor to populate my cabin with these brave little fighters, I developed a technique of servicing the colony in the bathtub, catching the escaped members in a bottle and quickly dropping the bottle into the case. This was done day after day as the leaves disappeared into the chamber containing the fungus garden.

On arrival in New York I was held up by inspectors from the Division of Entomology who carefully scrutinized the case before giving permission for it to land. When it was brought to the Park, I built a hollow second story, or addition to the case, to make it much higher. The enlarged casing was then provided with legs and placed in a commodious glass aquarium containing several inches of water. Extending from the nest are two wooden runways leading to a large pot of soil, also sitting in the water. The pot is kept supplied with cuttings from rose bushes and the idea of the extended runways is to provide parading areas for the leaf-cutters in such a way that they can be seen by visitors. The descriptive label carries a drawing to indicate what is inside the housing containing the nest.

When the arrangement was completed, I was again visited by a government inspector, who approved the exhibit as having met his department's requirements.

The parading of the ants has been intermittent, although much leaf material has been carried into the nest. The mound of earth above the fungus garden is now nearly a foot high. From what has been accomplished, much earth having been carried in from the large pot bearing sprays of leaves, it appears that the ants have been largely nocturnal in their major work. This has been disappointing, but there is hope for more spectacular, or visible, activity in advice I have just received from my friend, Dr. Neal A. Weber, who specializes in ants. He heard that I had brought a nest of *Atta cephalotes* from the tropics and sent me an article he has prepared about the species.* It contains a paragraph which reads: "Young colonies particularly and older colonies frequently are nocturnal or crepuscular in that they are active above the surface in cutting and gathering leaves only during the night or in the twilight."

I am hoping that with the growth of this colony, its habits will change to the industrious, diurnal processions that are among the most interesting sights of the tropics.

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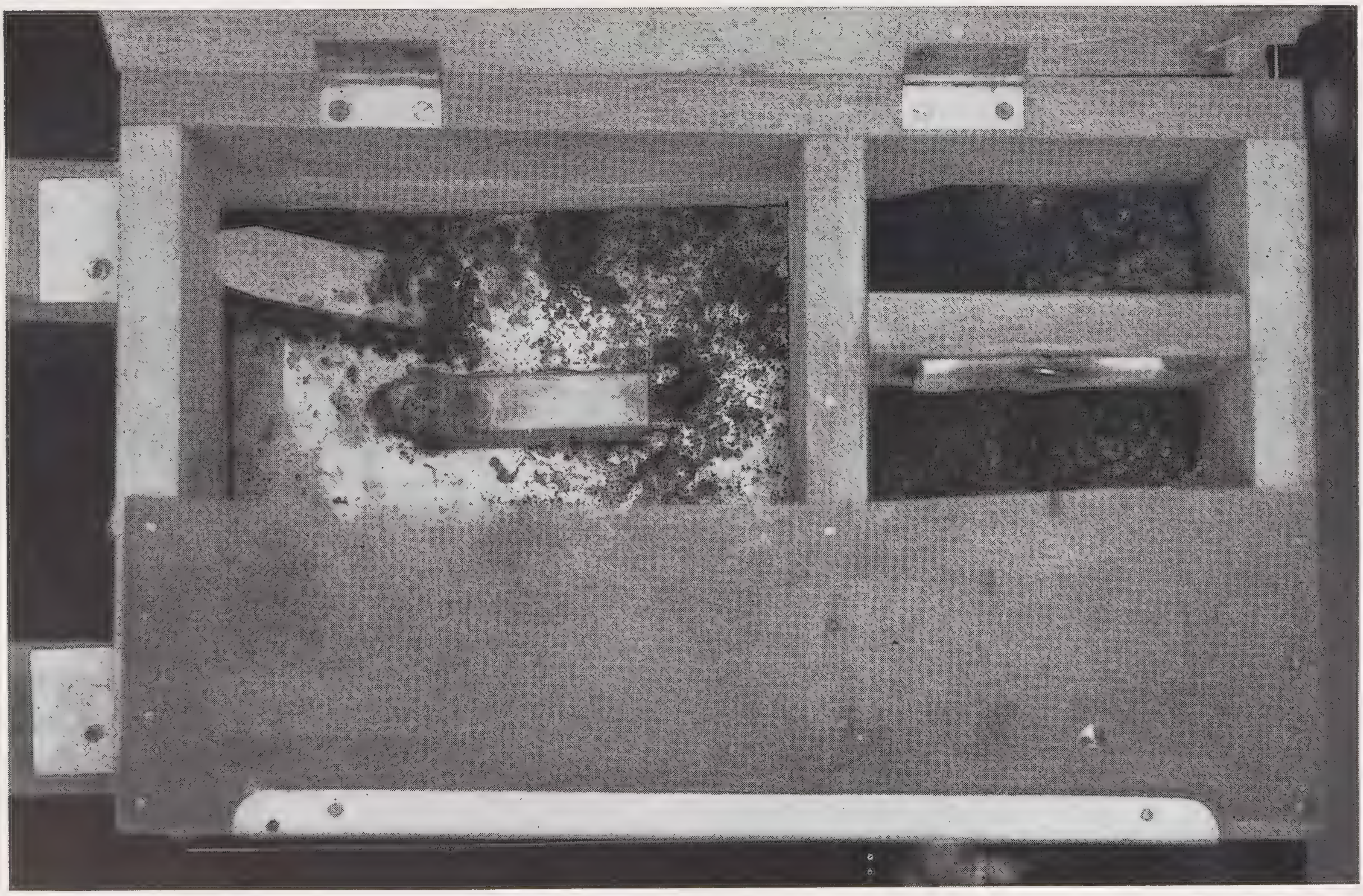
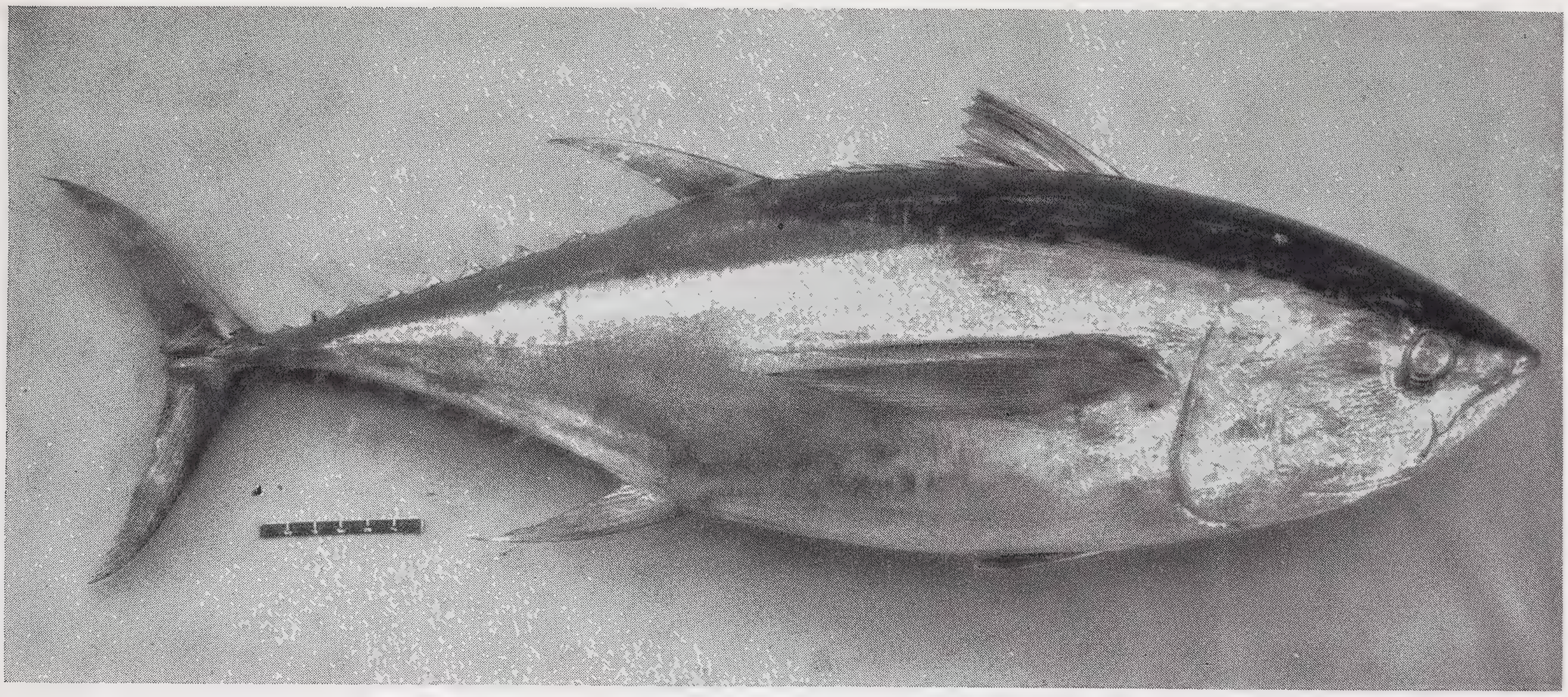
* "Tropical Agriculture," Vol. XIV, No. 8, pp. 223-226, with plates.



Looking down into the interior of the box that houses the Parasol Ant colony in the Park. Half of the top is covered by a fine-mesh wire for ventilation, and the open half can be covered by a hinged lid. The fungus ball is in the small compartment at the right.



Photograph by Toshio Asaeda

A yellow-finned tuna of the Pacific, Neothunnus macropterus. *The streamlining of these magnificent fish is close to the ideal form. The body is as smooth as possible; the spines of the dorsal fin fold into a groove, the upper margin of the pectoral fits into a depression.*

Tuna

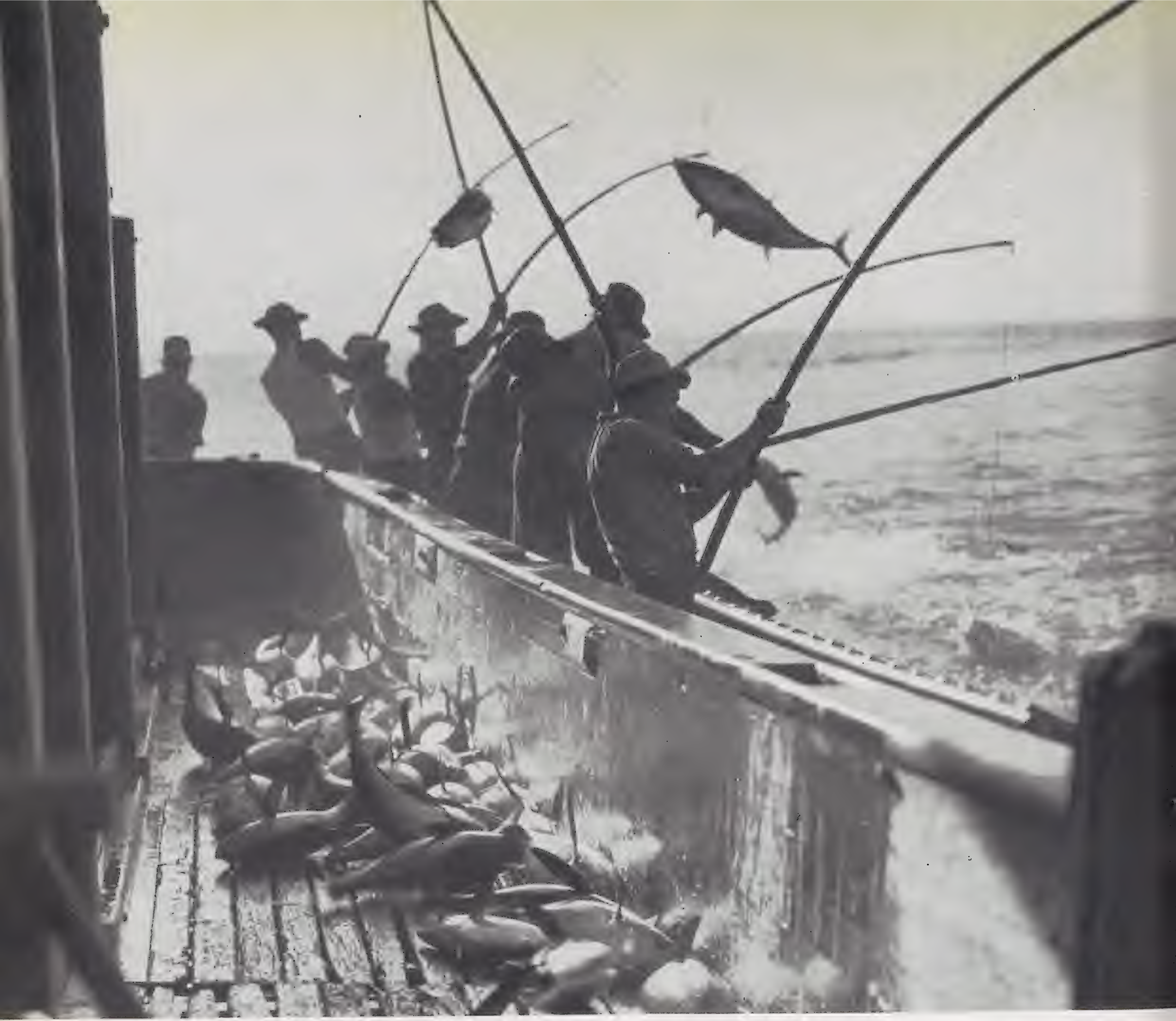
The Department of Tropical Research Goes Fishing for Tuna Along the West Coast of Mexico and Central America

JOHN TEE-VAN

FOR hundreds of years ladders have been used in the Mediterranean as aids in catching tuna-fish. In place of a ladder the southern California tuna-fishermen use selenium cells, automatic steering engines, coded wireless messages, sonic depth-recorders, powerful diesel motors, special hooks and bait-tanks and every modern and ultra-modern device that can be utilized. The ladders were successful as a means of enabling the fishermen to see when tuna entered their nets; the modern mechanical aids enable the fisherman to go thousands of miles *to* the tuna instead of waiting for the tuna to come to him, and by coded messages to bring his fellow fishermen to the slaughter.

The capture of tuna for food goes back into man's prehistory and it is of interest that as early as 600 B. C. these fish were used in the decoration of a wine pitcher that has been preserved to this day. An indication of the continued popularity of the tuna is that on the Pacific coast of the United States alone, the catch of "yellow-fin" tuna for the year 1934 was 61,000,000 pounds and was worth $3,053,229. The great West Coast fleet of vessels especially built for taking this species of tuna represents one of the peaks of man's mechanical methods of capturing salt-water fish.

Tuna are voracious fishes that travel in large schools. They feed upon almost anything in the ocean that moves and they descend to considerable depths for their prey. In coloration most of them are typical of their family, the mackerels—blackish on the upper surface, blue on the sides and bluish-silver below, with darker or lighter markings and marblings. The yellow-finned tuna, with which we are especially concerned, is richer in color than its relatives and a freshly caught fish, just in from the sea, is a gorgeous example of marine life. The back is blackish, the sides brilliant blue and the lower surface silver, while along the middle of the



Photograph by John Tee-Van

A two-minute haul of a tuna boat, the fishermen using the single-pole rig for fish of comparatively small size. Three fish are in the air and a fourth is just being hauled out of the water. On deck the newly-caught tuna are thrashing about, the tails of many high in the air.

sides from snout to tail is a broad, rich, golden-yellow band. Along the lower part of the body in freshly-caught smaller fish are groups of vertical spots and bands of pearly gray, while the caudal fin and especially the rays and finlets of the dorsal and anal fins are brilliant lemon- or golden-yellow. A few minutes after the fish has left the water this brilliancy vanishes.

At the present time the principal tuna used commercially are the blue-finned tuna of North Atlantic and North Pacific waters (*Thunnus thynnus*), known by many names such as tunny, giant mackerel, horse mackerel, etc., growing to about 1,600 pounds; the two large tunas of the eastern Atlantic, *Parathunnus obesus* and *Neothunnus argentivittatus,* and the yellow-finned tuna of the eastern and western Pacific (*Neothunnus macropterus*) which reaches a maximum of 450 pounds.

During the recent expedition of the Department of Tropical Research along the west coast of Central America on board Templeton Crocker's yacht *Zaca,* many yellow-finned tuna were caught from the stern of the yacht or from the ship's boats by Mr. Crocker himself. But it was a kidney stone in a ship's cook that introduced us to tuna by hundreds and thousands and to the Pacific coast fishing fleet.

Early in February while we were twenty miles off Cape Blanco, Costa Rica, towing deep-sea plankton nets five and six hundred fathoms beneath the surface of the sea, a radio request for medical assistance was picked up by our wireless operator. As the vessel asking for aid was equipped with short wave radio and we had long wave, there was considerable difficulty in effecting contact, but eventually, through other vessels, a rendezvous was made immediately south of Cape Velas on the coast of Costa Rica. It later developed that the surgeon-equipped ship nearest to the stricken man was in the Atlantic, with a narrow but complete continental width separating medical skill from the ailing human.

Just before dawn twenty hours later, in a fairly heavy sea, the *Zaca* and the tuna-boat *San Salvador* met and partly circled each other to make a lee for a small boat. A few minutes later in the intermittent flashes of searchlights we could see a dory coming across the white-capped waves. As it drew alongside the *Zaca* a husky group of Portuguese fishermen helped our surgeon, Dr. Eric Liljencrantz, plus his emergency kit and microscope, aboard and bore him away to their ill companion.

All of the morning the tuna-boat followed us down the coast toward Puntarenas, stopping to fish for tuna whenever possible and taking aboard some six tons during the few hours of fishing. In the early afternoon Dr. Liljencrantz sent word that his patient was resting and that he was ready to come aboard the *Zaca*. A few minutes later he arrived, bringing with him the captain of the tuna-boat who came to pay his respects and to tender thanks for our help to Mr. Crocker. The captain suggested that we come aboard his ship and watch them fishing. Thus came about our introduction to the tuna fleet of the Pacific coast.

The vessels of the tuna fleet, of which the *San Salvador* was an excellent example, are peculiar looking, highly specialized boats. Their strange appearance is brought about mainly by the huge, rectangular tanks near the stern which contain live fish for bait, the low after deck which is only a few inches above the water level, and the metal, grate-like racks fastened outside the rail aft, that form platforms on which the fishermen stand when fishing. The lowness of the after portion of the ship and the platform racks is necessary in order that the fishermen may be as close to the water as possible when they are hauling in fish. Another feature marking these vessels, is the conspicuous discharge of large quantities of sea water that pass through the bait-tanks to keep the precious bait alive. The *San Salvador* was about 122 feet in length, 140 tons net weight, powered with a single 500 horsepower diesel engine, with two auxiliary motors for generators, two ice machines for refrigeration and fuel tanks capable of storing sufficient fuel for propelling the vessel many thousands of miles. The crew, fifteen in number, were Portuguese, with the exception of the American engineer and radioman.

When the *Zaca's* tender placed us aboard the tuna-boat I was hurriedly introduced to the crew and led to the pilot house. The engine was started and we set a course, steered automatically by the selenium cells and automatic steering engine, away from shore. The entire crew, with the exception of the sick cook, gathered forward on the upper deck, watching in all directions for sign of tuna. Soon a rolling porpoise and a slight disturbance on the surface half a mile away gave evidence that tuna were about. Immediately the vessel's head was swung to meet the school. On board orderly excitement prevailed as the men went to the lower deck to pull on high rubber boots and waterproof clothing and to don small rubber aprons especially made to support the butts of fishing poles. As the fish in the school seemed to be small, each man selected a bamboo rod with a heavy, white-feathered, barbless hook and proceeded toward the stern of the ship. If the fish had been larger, two or even three poles and a corresponding number of men would have been used for each hook. Two of the fishermen, meanwhile, had climbed to the top of the bait-tanks and stood watching with their small bait-nets filled with scrambling bait ready to be thrown to the hungry maws of the fishes.

As we approached the school of tuna, the engines stopped and we swung about in a short circle, soon losing headway. Accompanying this was a short gruff order that released the fishing platforms and caused them to brush the sea alongside into a mass of white curling water. Every now and then a few bait-fish were thrown overboard with a resulting swirl of water as hungry tuna fought to capture this unexpected manna. Another short order as the ship stopped completely and lay in the swell, and the fisher-

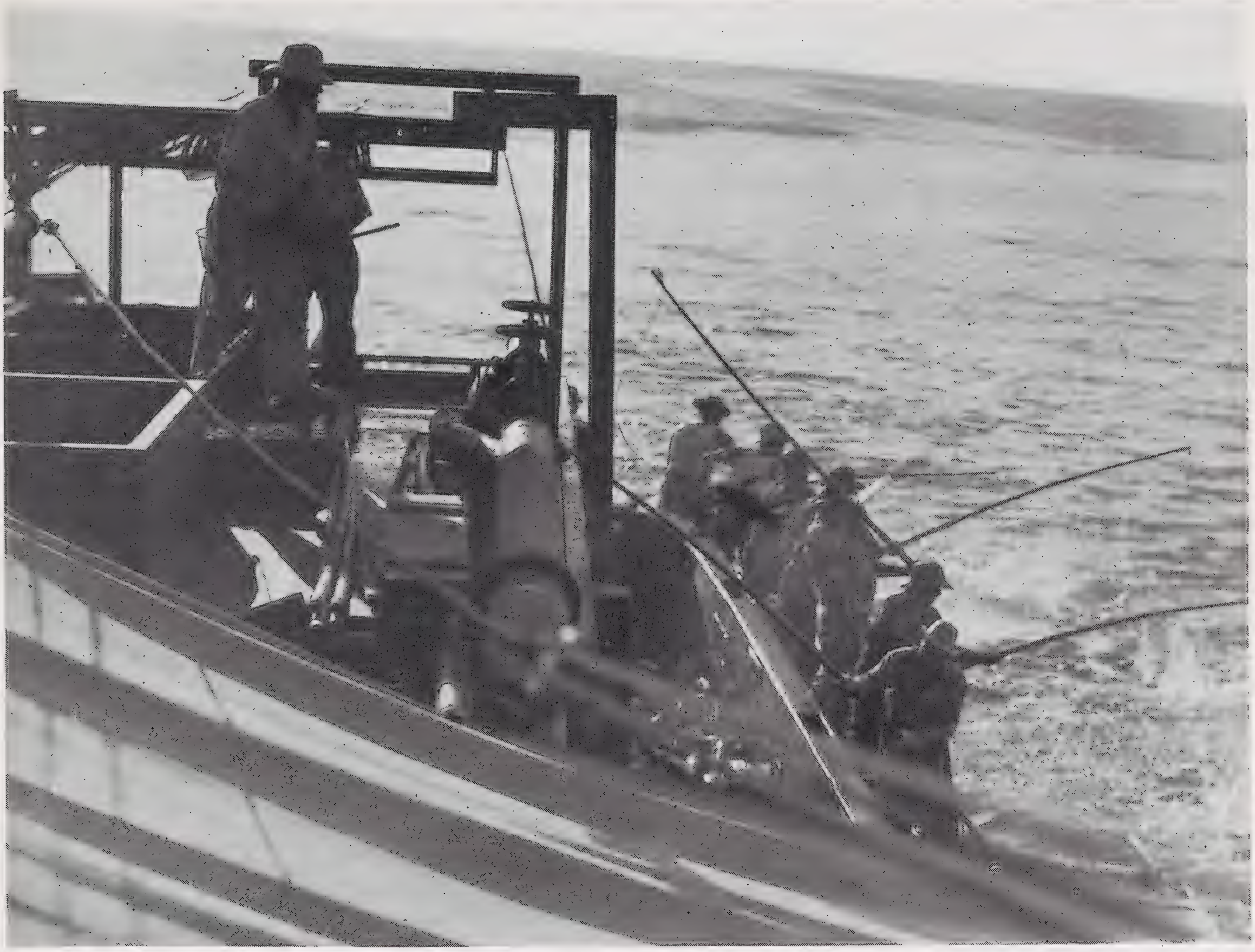
Photograph by Toshio Asaeda

The San Salvador *coming alongside to return Dr. Liljencrantz to the* Zaca. *On the lower deck forward are the cabins, engine room and galley, followed by the canvas-covered central open part of the ship and the bait tanks aft. This craft is typical of the tuna-fishing fleet.*

men clambered over the rail onto the metal platforms. Now began real excitement and for the next few minutes there was no place on board for a lazy man. As soon as the men were over the rail they braced themselves against the platform railings and the side of the ship and trailed the feather lures along the surface, while from above came the bait—*anchovettas*—that kept the fish excited and churning the water alongside.

An old illustration (London, 1883) *of tuna-fishing in the Mediterranean and the Adriatic. Nets, with one end held open, were set in the sea. When the men on ladders sighted tuna they signalled to close the net, and the fish were brought ashore.*

Soon a fisherman arched his back and with a smooth continuous motion pulled a tuna out of water, the fish moving in an arc over the fisherman's head, hitting the bait-tank, cascading to the deck where it violently flapped about, slowed down and settled into a trembling of the widely forked tail. As the fish landed on the deck the barbless hook slipped out from his jaws and the fisherman immediately swung his lure back to the water. By this time tuna were constantly in the air as one man after another hauled his fish on board. High overhead swung the tuna and as I photographed I could hear the constant battering sound of 20 to 30



Photograph by John Tee-Van

Tuna fishing as viewed from the upper deck of one of the boats. To the left are the hatches opening into the bait tanks and the two men whose business it is to throw the bait overboard. One man is hidden by the wooden cover protecting baitmen from the hooks of the fishermen.

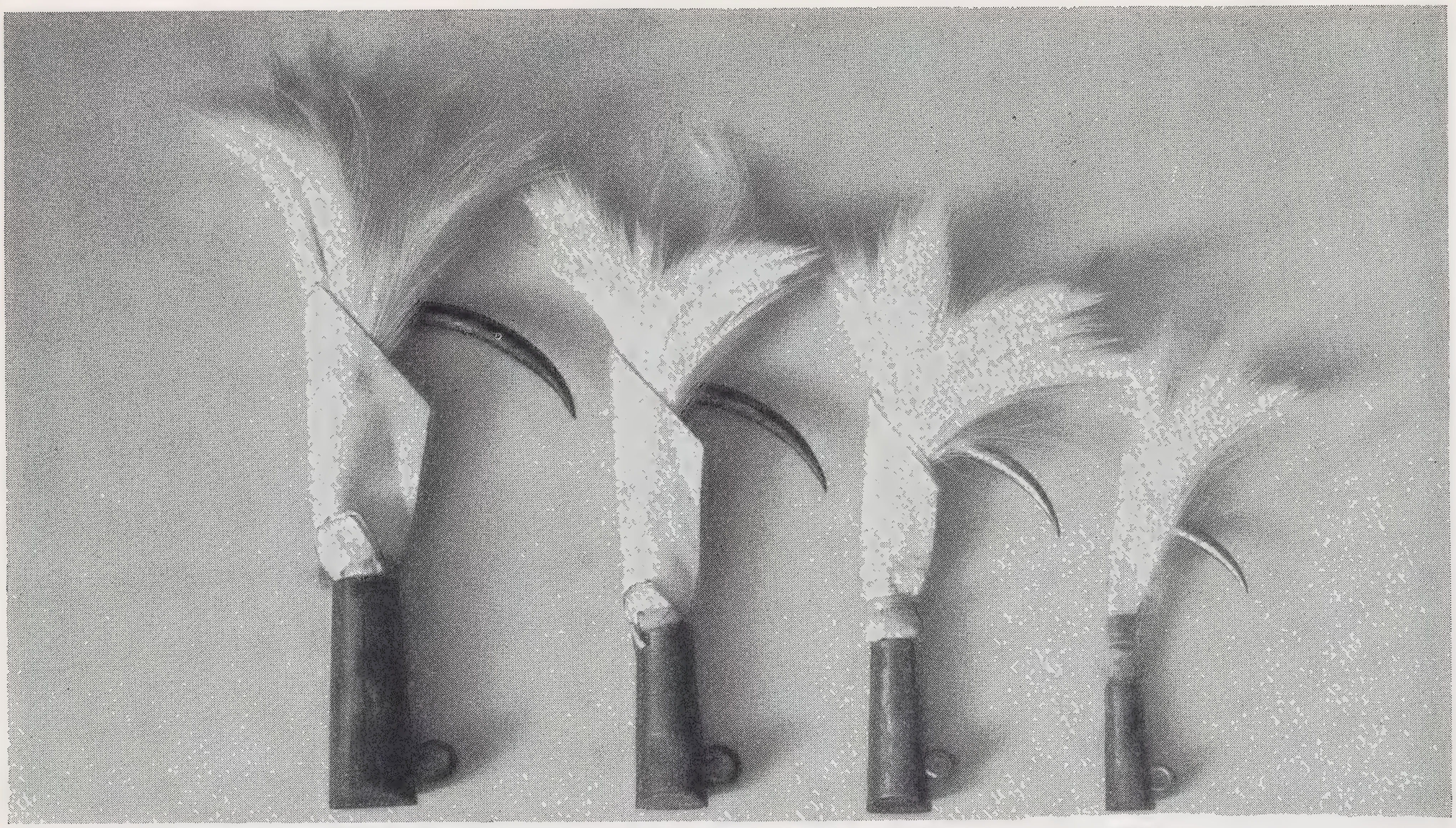
pound fish striking the deck, where they jumped about, occasionally completely clearing the deck in their violent thrashings.

Swinging the heavy, feathered lure overhead is one of the most serious causes of accidents on the tuna-boats and it is only the amazing skill of the fishermen that prevents them from striking each other constantly. The men most likely to be struck are those who throw out the bait and in most ships, they are protected by a heavy wooden cover over their heads. The others must take their chance.

Within three or four minutes this relatively small school was fished out, the men came back over the rail, the racks were raised, and the fish-poles placed carefully away. The tuna, held and supported by their tails, were passed along the deck to the hatches in the center part of the ship that led to the refrigerating rooms. Here they were spread on the deck, carefully washed and left to drain.

Meanwhile the ship was under way and the crew again on the forward part of the vessel watching for tuna. Soon the cry of "Fish!" arose and a few minutes later the men were on the racks, *anchovettas* flying from the bait-tanks and tuna hitting the deck. Again the sounds were the same, water rushing over the grated racks along the side, the small slap of *anchovettas* hitting the water, the resounding thwack when a tuna struck the deck and the rat-a-tat of their tails as they thrashed about, while above everything ran the constant throbbing exhaust of the vessel's diesel auxiliaries guarding the refrigerating rooms and preserving the catch.

As evening came we started toward the *Zaca* and preparations were made to store the fish.



Photograph by Edward Osterndorff

Feather-decorated, barbless tuna hooks. The lead-filled base holds the end of the sharply bent hook, while the lower parts of the feathers are protected by a sheath of parchment-like fish skin. The largest hook is 7¼ inches from base to tip of feathers. It weighs 5½ oz.

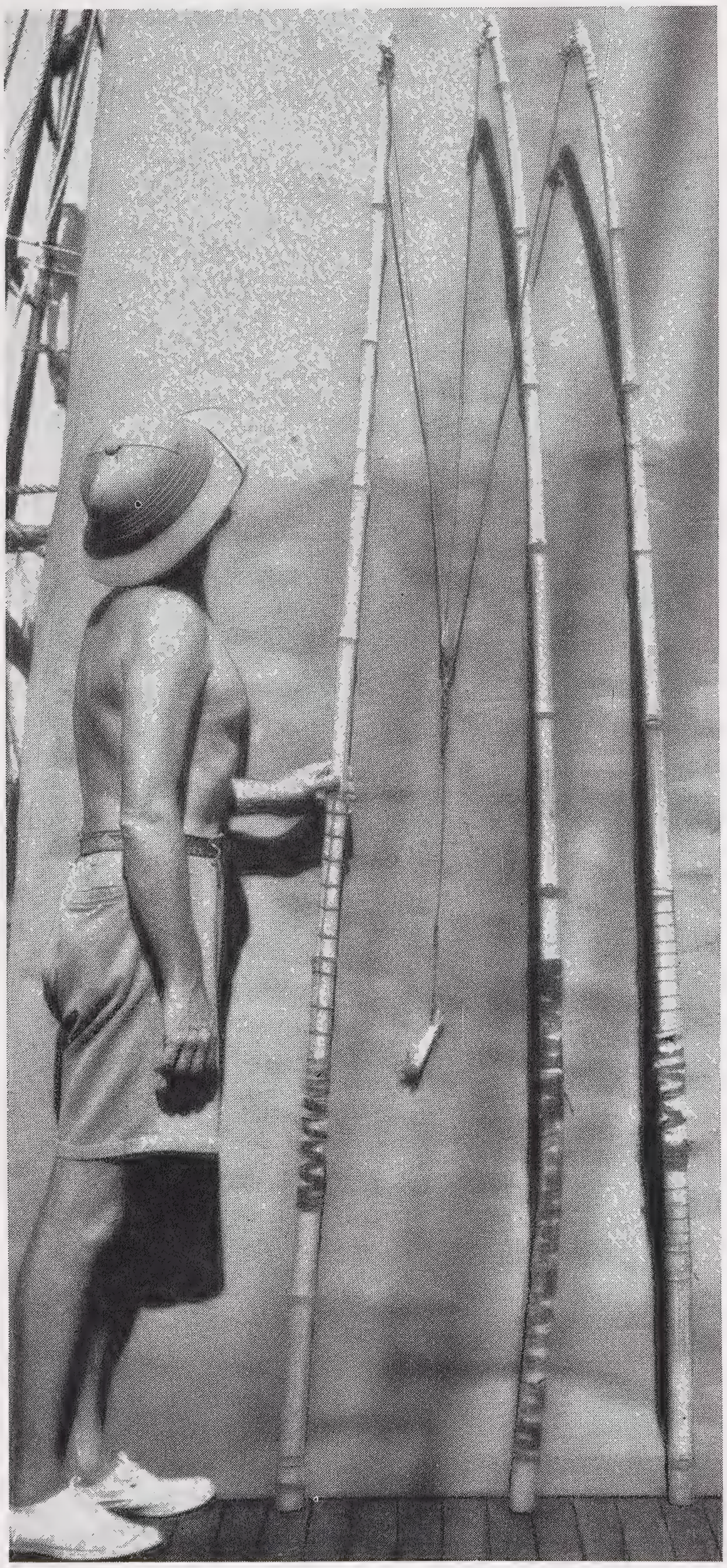
A half dozen men dressed in heavy woolen clothing, knitted pull-over caps, boots and sou'westers climbed through a narrow hatch into the hold where they landed on a floor of solid ice. In a few minutes the tuna, still handled by their tails, were sliding down a smooth, run-like depression in the ice to the lower depths, where they were carefully layered and covered with ice brought from San Pedro or San Diego. Above, the deck and the crew were being washed and a few minutes later clean-faced fishermen were enjoying their self-prepared supper.

During the return journey to the *Zaca* I had an excellent opportunity to look over the fishing rods and to examine the bait-tanks and the fishes that were used as bait. All of the rods were made of heavy bamboo, from 8 to 9 feet in length. At the tip of the pole there was fastened a heavy line some four feet long from which depended first a swivel, then a length of brass or bronze wire and finally the heavy, brass-ended, feather-decorated barbless hook. These were the poles used in catching fish from 20 to 30 pounds in weight—so-called "one pole tuna." When fish of 30 to 50 pounds are being caught, two men work together as a team and fish with a combination of two poles and one hook, and with still larger fish three, four or five men join together to bring in the fish on their single hook. The utilization of the barbless hook is the only method that makes the fisheries commercially possible, as no time is lost in unhooking the animal once it has come onto the deck and the tension relaxed. Other fish poles on board were equipped with simple curved hooks that are baited with fish and used when the feather-enhanced hooks would no longer lure tuna.

Climbing up to the top of the bait-tanks revealed the open hatches where, in a milling whirlpool, silvery fishes unceasingly swam about. The fishes in the tanks of the *San Salvador* were a large species of anchovy (*Cetengraulis mysticetus*) ranging in length from four to six inches. These had been captured in Costa Rica's Gulf of Nicoya and they are favorite bait of the tuna-ships operating in southern waters. The fishermen called them *anchovettas*. Farther north, in colder water, the sardine (*Sardinia caerulea*) is preferred.

Next morning at daybreak our surgeon revisited his patient of the *San Salvador* and pronounced the man fit and able to go on, after which the tuna-boat went to sea and we to

Puntarenas. Just as we started to tie up to the pier for fueling, we were forced to cast off our lines, as the tuna-boat *Belle of Portugal* was making an emergency docking with a seriously burned man. Our surgeon again came to the rescue. By now the *Zaca,* with her owner and surgeon and crew, had become synonymous with the "Good Samaritan" and the tuna-boats, of which there were usually from six to twelve in the harbor, offered their services for anything that we desired in the way of fish.



Photograph by Toshio Asaeda

A three-pole tuna rig, showing the method of attaching a single hook to three poles. Wire and strong swivels connect the hook to cords attached to the fishing rods.

We asked for large tuna so that we might measure and examine them, and large tuna came aboard somewhat more rapidly than was comfortable. A request to see the tuna in the refrigerators was followed by visits, clad in heavy clothing, to ice-chests where we shivered and examined hundreds of solidly frozen fish. Among other things we were asked if we would care to go out at night on one of the ships and watch them catching bait.

Late that afternoon we went on board the *Westgate* where preparations were being made for the evening's work. Backed to the stern of the ship was a powerfully-engined, specially-built motor boat about 22 feet long, so constructed that all projections that might catch in the meshes of a net had been eliminated. Into the after end a seine or lampara net, 720 feet long and 72 feet deep, was being carefully stowed. Later, towing the motor boat and a skiff, we started off toward our destination some ten miles away in the mouth of the Gulf of Nicoya. When we were a mile or so off Negritos Island the engine was stopped and we lay to, three other tuna-boats being about a quarter of a mile away. It was not yet dark so the crew leisurely garbed themselves in rubber boots and trousers and prepared the ship for the reception of the bait. As night crept on, all lights except the port and starboard and masthead were extinguished. Soon the mutter of the vessel's exhaust interrupted the still night and we slowly moved ahead. Overside the smoothly curving bow-wave was a breaking crest of cold blue luminescence as countless thousands of disturbed organisms contributed their little flash of burning energy to the general illumination. Farther back and away from the ship were three similar wavelets of the same cold fire. We cruised about for fifteen minutes and stopped, waiting for increased darkness and for sign of a school of bait fish. Nothing developed and we started off again. Two minutes later an elongate, phosphorescent, chevron-like figure about 150 by 30 feet showed up beyond the bow of the vessel and with a last sputtering gasp from the engines we slowly drifted into the glittering lambent school, the fishes of which we could not see but whose presence was indicated by the activated lights of minute marine animals.

On deck there was a great deal of activity as ten of the crew boarded the motor boat and skiff. In a minute they were free of the mother vessel, rapidly circling the school and rounding it into a condensed ball. After two round trips, the skiff, to which one end of the seine had been attached, was released, while the motor-boat, feeding out the net as fast as possible, completely encircled the school of fish with a wall of thread and then nosed up to the skiff. Shortly a light from the motor boat signalled the completion of the job and the *Westgate,* with all lights blazing, slowly and carefully backed toward the motor boat. Lines were thrown from boat to ship and a few minutes later a section of the net was aboard the larger vessel. Continued hauling on the net brought more and more of the seine on board until eventually all of the fish had been corralled into a single small pocket lying in the water between the ship and the launch.

Two men with heavy poles now held the motor boat off the side of the ship while others prevented the net from slipping away. Five fishermen formed a fish bucket-brigade—except that it ought to be called a net brigade, as the containers were small dip nets. As fast as they could, the five men worked, the first one dipping down into the mass of struggling silvery fish, taking up a scoopful, passing the net to the next man who handed it on until it reached the last of the five. This one, carefully and gently, allowed the fish to escape into the bait-tanks. Everyone continued working as rapidly as possible until the entire lot of fish, some fifty-eight scoops, each amounting to a small pailful, had been deposited in the tanks. Six hundred scoopfuls represented the capacity of the *Westgate's* tanks.

Meanwhile, the supply of fresh sea water had been increased until the maximum amount of water possible poured through the bait-tanks, bringing much needed oxygen to the excited fish. A large piece of netting covered the hatchway to the bait-tanks and the necessity for this was soon evident as the entire mass of bewildered fish rushed to the surface in a whirling silvery mass at the first exhaust of the engines. Vibrations are especially noticed by newly-caught fish and the same rush to the surface can be secured by stamping on the tops of the tanks. In a short while, however, the fish become accustomed to their circumscribed surroundings and it is unnecessary to keep the tanks covered.

The *Westgate,* after the net had been carefully replaced in the motor boat, continued to circle, and with all our lights extinguished we could see many illuminated groups of fish in the blackness of the sea. Some of these were small, ten to fifteen feet in diameter, others ranged up to a giant aggregation at least 250 feet long, 40 feet wide and no one knows how many feet deep. They moved slowly, amoeba-like, with many silvery-blue pseudopodia-like extensions, until a dart of preying jack or mackerel produced a hurried shrinking in size and a violent intensification of illumination.

Large schools of fish such as the one mentioned above are not desired by the fishermen, as I was told that the number of fish taken in a single net on a foray against such a school might be so great that the weight of the fish would carry the net away from the fishermen and endanger the men and the small boats.

While the motor boat was attempting to round up another school of fish a sudden squall arose. As we watched, the tips of waves could no longer be called white caps but must be termed blue-caps. Each broken segment of wave-tip, as it curled and fell, turned into living flame, like flowing, fantastically-shaped blue opals. A few minutes later the motor-boat appeared alongside and the fisherman reported that it was too rough to work. With the *Westgate* forming a lee, the net was taken aboard, the motor boat and skiff fastened astern and we proceeded toward Puntarenas and the *Zaca.*

In the bait-tanks the newly captured fish were slowly and quietly milling about and with this the amount of circulating water in the tanks was reduced. Very few of the newly captured fish had been incapacitated during their capture and evidently skilful handling brought the vast majority in safety into the tanks. With the 58 scoopfuls the *Westgate's* tanks were almost full and a few days later she would be ready to go to sea for tuna.

Like all fishing ventures, the tuna-fisheries are uncertain. Bait may be scarce and hard to find. Sometimes the economic situation may cause a diminution in the demand for certain sizes of fish; thus during the spring of 1938 only tuna smaller than 50 pounds were being accepted by the canneries. Second-grade tuna-like fish, such as skipjack, are often of little or no value when brought into a glutted market. Added to these troubles is the possibility that the vessel may occasionally catch large amounts of what is called "green-flesh" tuna. The flesh of these fish, when cooked, becomes flabby and sponge-like, completely worthless for canning. Unfortunately for the fishermen, this condition cannot be ascertained by examination and the result is that a certain percentage, often large, of fish is discarded after cooking by the cannery. Although not definitely known, it is probable that the "green-flesh" is to be found in fish that have recently bred and thus are spent.

Another example of the uncertainty of the fisheries was exemplified by a temporarily disabled net tuna-boat that we met in Piedra Blanca Bay. This vessel had been at sea for nearly seven weeks, having left her home port of San Pedro and traveled as far south as the Galápagos Islands and the coast of Peru. After this trip her refrigerators carried only ten tons of fish—less than a twelfth of their capacity. It is necessary to mention, however, that this vessel was fishing for tuna with large seines and did not carry bait tanks. The bait boats usually do not have disappointments as great as this.

Many nationalities man the tuna-boats but the preponderance of fishermen that we saw at Puntarenas were Portuguese and Japanese. Considering the great tuna-fisheries of their homelands, it is not surprising to find men from these countries in such large numbers. Each American vessel of the fleet, however, carried an American engineer and radioman.

The saga of the tuna fleets remains to be told and when it is written it will contain material and stories as rich as those of the fishermen of Lofoten or of the Grand Banks. For while the tuna-fishermen are heir to all the hazards of deep-sea men the world over, they have other dangers that are peculiarly their own.

Photograph by Toshio Asaeda

Some of the vessels of the tuna fleet at anchor in Puntarenas, the Pacific port of Costa Rica. Here large amounts of tuna are temporarily stored ashore in a specially-built refrigerating plant. Later the fish are taken by steamer to the cannery at San Diego or San Pedro.

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Notes from the Zoological Park, Aquarium & Department of Tropical Research

"Seahorse" in the Hurricane

When the West Indian hurricane passed through the New York area on September 21 the Aquarium's wellboat *Seahorse* was industriously going about her business of gathering fall specimens in the neighborhood of Sandy Hook. The suddenness and intensity of the storm took the crew by surprise.

However, they managed to make fast to the government dock inside Sandy Hook, put out six lines to hold the 6-ton, 35-foot vessel, and headed her into the gale with the motor at full speed. For a short time this berth seemed safe enough, even though much of the deck equipment started to move away and the men had to crawl on their hands and knees to keep from being blown overboard.

Then the water began to rise under the force of the wind and the dock was completely submerged and started to break up. The lines from the *Seahorse's* starboard side pulled her over at a crazy angle and at this point the crew donned life preservers.

They debated whether to abandon ship, but the decision was made for them very shortly when the hulk of an offshore purse seiner hove into view, almost completely out of hand and headed straight for the *Seahorse.* The wellboat's crew jumped for the stringers of the dock and floundered to land through waist-high water.

The seiner, the *E. S. Dickerson,* struck the *Seahorse* a few minutes later, but fortunately not head-on. The port shrouds were carried away, as was the guard railing on both sides. The propeller shaft and blades were bent and the steering mechanism was damaged, but the hull remained sound.

When the blow eventually subsided, the bedraggled crew made the nearest point where preliminary repairs could be undertaken. A final bill of $660 for repairs and $142 for lost equipment was approved by the insurers.

We were fortunate in not losing the crew, or losing the boat completely. In a way the *Seahorse* probably suffered less where she was than she would have in her berth at the Battery, where she might have been dashed to pieces before anyone could have gone to her rescue. The police boats that also berth there got under way and put out to safety, but they of course already had crews aboard when the hurricane struck.—C. M. B., Jr.

First Rock Beauty

The Aquarium acquired its first rock beauty, *Holocanthus tricolor,* this fall, thus ending a search of many years.

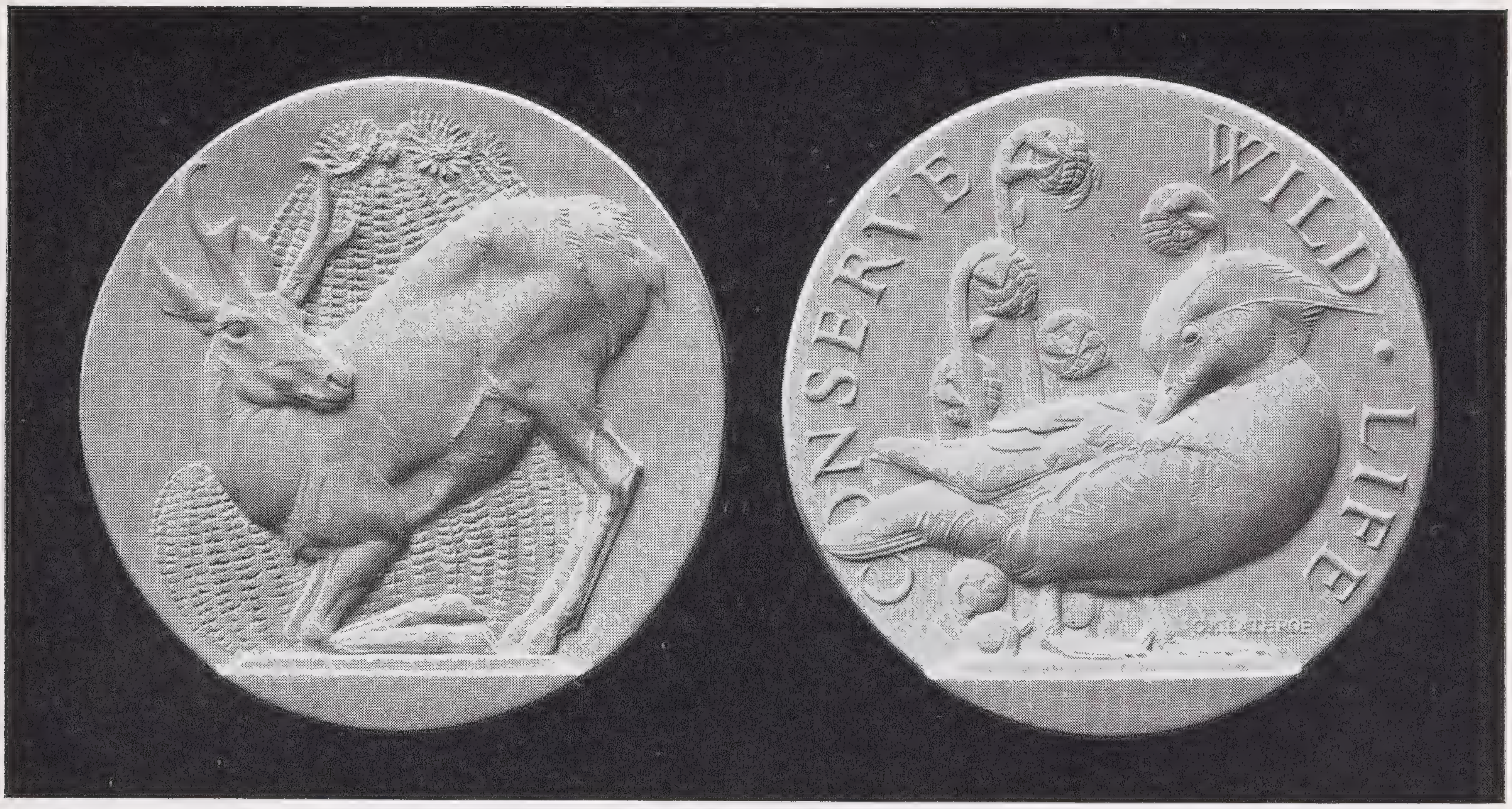
Ever since the establishment of collecting stations in Florida, and ever since our own collectors have been making collecting trips to Florida and the West Indies generally, attempts have been made to procure one of these most beautiful of all the butterfly fishes. One was caught in Bermuda, but died before it could be transferred to shipboard. No other was ever captured for us until the present specimen was taken by a commercial collector at Alligator Reef. Most other aquaria have been no more fortunate, the only rock beauty arriving in any northern aquarium being taken this year at Key West for the Shedd Aquarium in Chicago. Marineland, the new type of aquarium at St. Augustine, Fla., has exhibited several of them for short periods.

The scarcity of these fish in captivity might be considered remarkable since as much as $50 has been offered to fishermen for years for a living specimen in good condition and since the great ichthyologist, Dr. Evermann, reports that the fish are taken in quantity in traps and are valued as food.

What makes this fish so desirable for exhibition is the superlative value of its color. Mature specimens are a rich orange on the fore-part of the body and on the tail, while a velvety black covers the latter portion of the body and most of the anal fin. The edges of this and the dorsal fin and the gill covers are red. The lips are brilliant blue. Mature specimens reach about a foot in length. The one in the Aquarium is not above two and a half inches over all; it is immature, and the orange and black are the only colors visible.

The fish seems to be in good health and eats chopped clams three times a week. It has made itself at home in its tank and evinces a more than ordinary interest in its surroundings.—C. W. C.

Mr. William C. Bennett, Chief Engineer of the Aquarium, has been elected president of the New Jersey Fish and Game Protective Association, Incorporated, as of October 26, 1938. This is a formal acknowledgement by an important and state-wide organization of the services of Mr. Bennett, who has been active in the protection and propagation of wild life for many years.



Courtesy Society of Medalists

The bronze medal which Miss Lathrop created for the Society of Medalists—a pronghorn antelope and a wood duck, both superbly modeled from living specimens. This medal was the eighteenth in the specially struck series issued to the members of the society.

Conservation Medal

Miss Gertrude K. Lathrop, the sculptor of the medal illustrated above and author of the comments on conservation printed below, is a sculptor of note whose work frequently has animal subjects. She has often worked in the New York Zoological Park. Miss Lathrop's studio is in Albany.

When our forefathers first came to this country, they saw such an abundance of wild life that they never dreamed that in a few years some of the species could be seen only in museums, and many would be carefully guarded in zoos and reservations, lest they stand only behind glass, side by side with the great auk, the Labrador duck, the Pallas cormorant, the passenger pigeon, the heath hen, the Carolina parakeet, the California grizzly bear, the Arizona elk and certain subspecies of the bison and mountain sheep—stand, poor imitations in skin and plaster of the beautiful creatures that were considered worthy of creation.

It is not a judgment upon us that many things happen, but only that we have upset the balance of nature, and nature relentlessly reacts. The farmer finds that the owl and hawk are stealing his chickens, and the crow is pulling his corn. He shoots them. Freed of their enemies, the mice girdle his young fruit trees and steal his grain, and the grasshoppers and other insects devour his crops. He kills the fox and coyote, and hares chew on in ever increasing numbers. When the mountain lion and grizzly bear are shot in the deep forest because they kill the hunter's game, the deer in that locality increase beyond belief, and he looks with dismay at the ruined woodland, stripped of leaves, twigs and bark by the starving animals. Flocks of sheep and herds of cattle occupy the plains that once belonged to the bison and antelope. Lions, bears and wolves are killed that lambs and calves may live. But these huge masses of animals have cropped the grass to the roots, and the ground, in protest, rises up in a dense dust storm, and settles back, choking animals and people alike.

Every year the United States issues about thirteen million hunting and fishing licenses. The true sportsman abides by the law, helps to alter it, regardless of revenue, when it becomes inadequate, takes less than the bag allowed, and gives his animal a sporting chance. He has nothing but contempt for that huge army of killers that go forth, in and out of season, with repeating and automatic shotguns, baiting as they go, and hiding that extra duck from the warden. Every year many traps are quietly laid where fur bearers are likely to walk. The true woman protests with indignation when she sees an animal hurt, but how often does she ask how her furs are trapped, or if the fox, whose skin is to lie softly around her shoulders, pulled in agony for hours, or even days, at a foot crushed in the teeth of a steel trap? If she could see what happened, she would demand that only humane traps be used. For it was not long after the Audubon and other humane societies acquainted us with the unbelievable cruelty inflicted upon America's most beautiful bird, in taking its plumes, that women no longer wore egrets.

On my medal I have shown the pronghorn antelope and the brilliantly colored wood duck. Both were fighting for existence a few years ago, but through the efforts of conservationists they have rallied, though America's only antelope, like many other animals, exists almost entirely on reservations. Land has been drained and improved, but the duck has been left without breeding ground, and the game bird without cover. Poison has been scattered wholesale, but the United States Biological Survey has gathered up the bodies of many besides predators that have eaten of their poison, and have died. The eastern cougar and Esquimo curlew are thought to be extinct, but there may still be time to save many whose numbers are greatly depleted—the mountain sheep and goat, the eastern woodland caribou, the moose, the bison, the grizzly bear, the eastern mountain lion, the wolverine, the otter, the fisher, the martin, the northern elephant seal, the California condor, the ivory-billed woodpecker, the trumpeter swan, the whooping crane, the canvasback and redhead ducks, the great white heron, the American and snowy egrets, the wood ibis and many others. The way to try to save them is to attempt to provide them with conditions under which they will thrive, and not to kill them. There are many of us who will fight for them, that we may see them, not only behind glass, but walking, running, flying and swimming as they fulfill the mission for which they were created.

It Was "rubrifrons"

Latin names of animals, which so often dismay the layman by the difficulty of pronouncing and understanding them, sometimes lead the professional zoologist astray because he understands them too well.

Recently Curator Crandall received from an animal dealer in Panama a bird which the dealer was unable to identify. It was, obviously, one of the tanagers. Searching for it in a standard work on the birds of that area, the curator ran through the identification key several times and always it led to a species named "*rubrifrons*."

That word, in ornithologist's Latin, means "red fronted"—and the bird in hand very definitely did not have a red front, or crown.

When the key led him invariably to the same species, Curator Crandall resolved to see what this mysterious "*rubrifrons*" was, anyway. When he turned to the detailed description, the matter was made clear. In the type specimen, on the basis of which the bird was originally described and named, most of the feathers of the crown were tipped with dull reddish-brown, and consequently the name of *rubrifrons* was applied. That coloration appeared to have been accidental; no other examples of the species have been found with similar markings. However, the original name still stands.

The bird turned out to be Lawrence's Tanager, *Heterospringus rubrifrons*, an extremely rare bird and the first one to appear in our collection.

Among the fish arriving periodically from Florida, the Aquarium has received two octopuses which seem to be adapting themselves well to life in captivity. The only unfortunate aspect of their display is that, like all of their kind before them, they refuse to move about in daylight and do almost all their prowling at night.

Memorial to the Bison

The American Bison Society, which was founded in the Zoological Park in 1905, has long had it in mind to erect a memorial to the bison on the western plains. A tentative site has now been selected near Scottsbluff, Nebraska, in the heart of the old buffalo country.

Martin S. Garretson, Secretary of the Bison Society, chose the site during a recent trip to Nebraska to attend the annual meeting of the Oregon Trail Memorial Association at Scottsbluff. Countless thousands of buffalo roamed that region in the old days and the Oregon Trail, a famous route to the northwest, ran through Scottsbluff.

A main highway, used each year by thousands of motorists on their way to and from the Yellowstone National Park, passes the State Game Preserve outside of the city, and along this road, in the Wildcat Hills about ten miles southwest of Scottsbluff and within two or three miles of Mitchell Pass, Mr. Garretson found a site that seems ideal for the purposes of the memorial.

It is a slight eminence in the prairie, directly alongside the highway and yet inside the buffalo pasture, behind the Game Preserve fence. The highway at this point runs along the Oregon Trail, and the Game Preserve itself is "buffalo country" as it was in the days of the great herds. It has never been ploughed, and buffalo grass still grows on it.

On this mound Mr. Garretson has recommended that the American Bison Society set its monument to the vanished wild buffalo. If sufficient funds are made available, the monument will take the form of a bronze statue of a bison bull, about one-third life size. If the cost of this type of memorial cannot be met, an alternative suggestion is a boulder into which a bronze plaque can be set.

The model for the memorial, whether it be a figure of a buffalo or a plaque with a bas-relief, will be the famous bison bull known as Black Dog. This magnificent animal, born in the New York Zoological Park, was sent to the Wichita Game Preserve in the nucleus herd of fifteen animals contributed by the New York Zoological Society in 1907.

The greater part of the main Bird House will be closed to visitors for most of the winter while the building is being re-roofed. A false roof has been laid under the glass, to keep out the weather when the glass is being replaced, and the interior of the house is consequently quite dark. Lights are being kept burning in the illuminating panels at the tops of the cages, and the birds apparently are quite satisfied with the artificial sunlight. There was considerable noise in the house while the false roof was being laid but it did not seem to disturb the inmates.

The Bird Department's collection of ruby-throated humming-birds was increased by three specimens during September, possibly as a result of the hurricane. The birds, in an exhausted condition, flew into buildings in the Bronx and Manhattan and when they were reported to Curator Crandall he sent for them, few them on artificial nectar, and managed to bring them around.

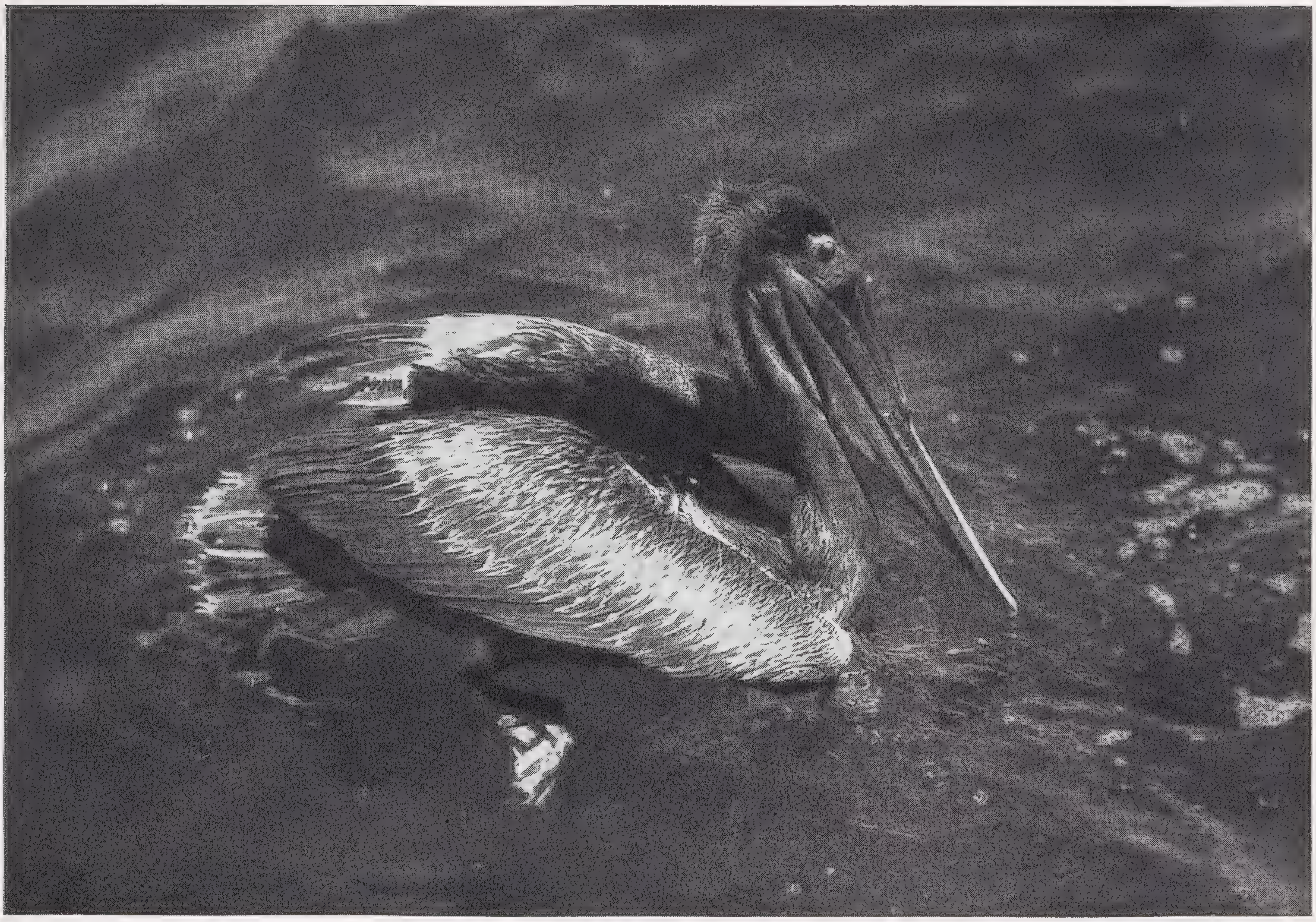


Photo by John Tee-Van

The survival of the unfit is exemplified by this brown pelican, which manages to survive the competition of its fellows in the Bay of San Lucas. More than half of its upper mandible is missing, which makes it difficult for the bird to catch fish. Tameness is an advantage, however.

Survival of the Unfit

After many years of scientific disregard or actual condemnation, Darwin's "survival of the fittest" is slowly regaining importance in evolutionary consideration. The experience of the Department of Tropical Research with living wild creatures in their native haunts has tended to make us exaggerate rather than to underestimate the significance of this phenomenon. Now and then our opinion is strengthened by the inevitable exception which proves that there must be a rule.

On Nonsuch Island in Bermuda we spent many profitable hours with our 12-20-40 power binoculars in watching the habits of migrating shorebirds. The commonest of all the seventeen species of waders was the ruddy turnstone (*Arenaria interpres morinella*), also known among our sportsmen as Calico-back, Brant-bird, Horse-foot Snipe, Beach Plover, Heart-bird and Sea Quail. After nesting in Baffin Land the turnstone is found as a common spring and autumn migrant along our Long Island beaches.

Several notes from my journal show a series of significant conditions:

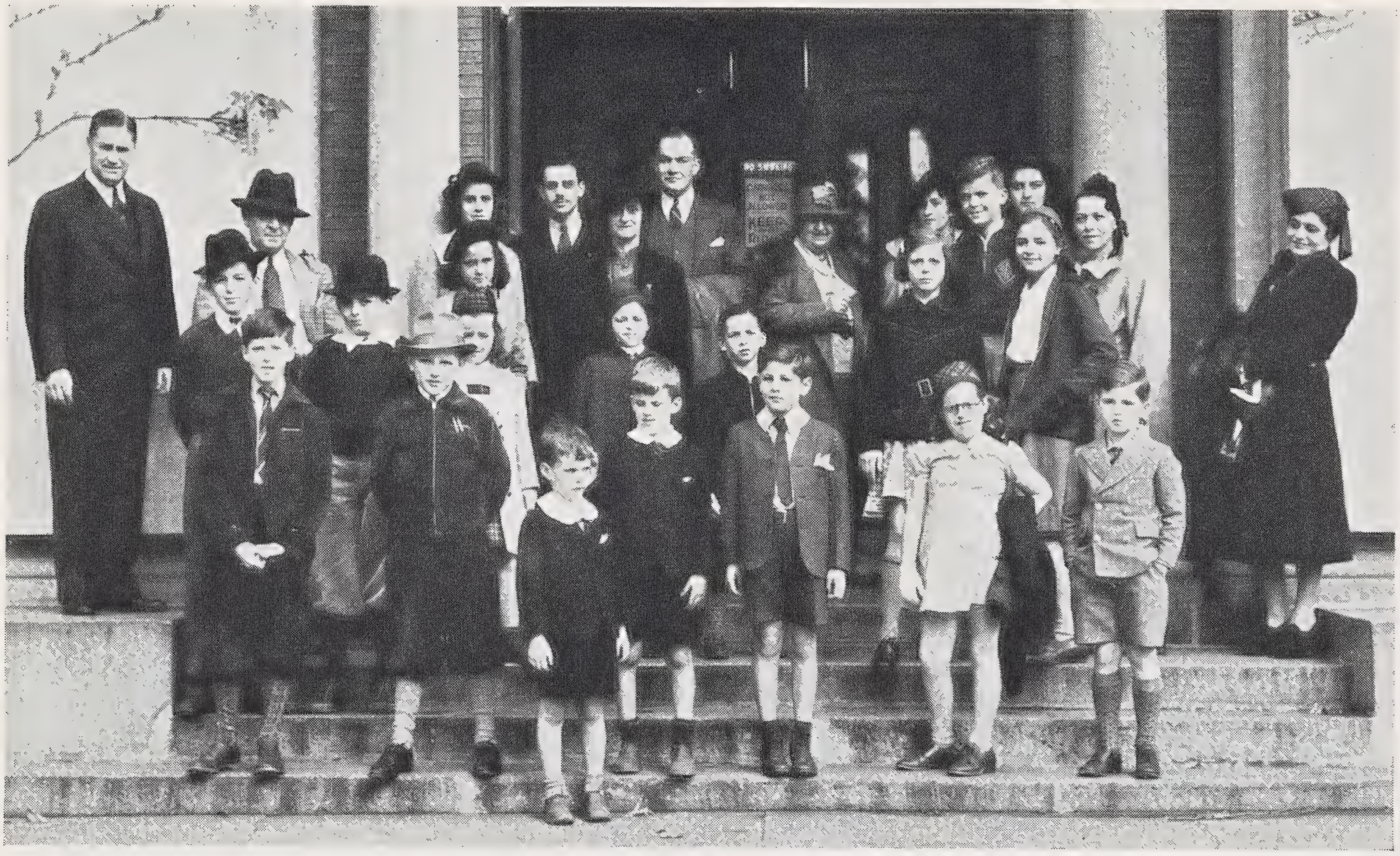
September 7, 1929—Seventeen turnstones on South Beach, two of which are cripples. One, a female, has the right foot bent far over and stiffened. The other is a male and has lost the entire right foot, toes and metatarsus, the limb having healed at the tarsal joint. The plucky bird balances perfectly and stumps easily about, feeding and holding its own in every way. Strangest of all, its fellows often quarrel among themselves over a rich find of sandhoppers, but all give way to the cripple.

June 7, 1930—Nine turnstones on South Beach, one of them the identical cripple seen a year ago, a male in normal plumage.

May 17, 1931—Three cripples among a flock of ten birds. Two of these I saw in 1929 and one last year. A diagram I made at the time, of the peculiar arrangement of the inbent toes of the female and a hardened, inward projecting flap of skin seen at the stump of the male's leg, leave no possibility of doubt of the individual identity.

August 17, 1931—Of four turnstones, three are cripples, one a new one with the left leg hanging loose, swinging about, so the bird has either to hop or squat flat. It is a male in good plumage, and feeds as well as a normal bird. The tarsal-stump male is the same seen in 1929 and 1930.

We know how the slightest handicap of abnormal structure or even color is usually soon fatal to a bird, slain either by a keen-eyed hawk or by the savage assaults of its own kind. Yet here were birds migrating year after year, holding their own and undisturbed by members of



The first arrivals among the group of Members of the New York Zoological Society and their children who attended the "Zoo Saturday" tour of several of the Park buildings on Saturday, October 29. A second tour for children was conducted the following Saturday, November 5.

their own flock; cripples with a distorted foot, a dislocated upper leg, or actual loss of one leg. None of them remained in Bermuda after the periods of north migration.

Any similar observations on the part of members of the Zoological Society would be well worth recording.

On the first of April, 1936, from the deck of the *Zaca*, we saw, in the Bay of San Lucas, a brown pelican which was astonishingly tame, swimming up to the very side of the yacht or an incoming tuna-boat, and gazing hopefully up at us with that irresistible, unconscious comedy which only a pelican possesses. We threw it a fish which it failed to catch, the reason being, as we then saw, that more than half of the upper mandible was missing. A moment later the bird dived sideways and retrieved the morsel. We experimented and found that it had developed an entirely unpelicanlike plunge, thus obviating the serious handicap. A Mexican custom official told me that he had seen this individual bird for at least two years. The pelican was well nourished and its extreme tameness gave it an advantage over its slightly more wary companions.

These examples of the survival of the unfit are rare indeed, a weakling or an injured bird or mammal usually having short shift even from members of its own flock or herd. Mankind alone consciously contravenes this law by caring for and prolonging the lives of its physically and mentally incapacitated—the halt, lame, blind, criminal and insane.—W.B.

"Zoo Saturdays"

The first of what it is hoped will be an annual fall and spring series of tours of the Zoological Park, for the children of Members of the Society, were conducted by Dr. Claude W. Leister on Saturday, October 29, and Saturday, November 5. On the first "Zoo Saturday" 89 children and adults accompanying them had given notice that they would attend. The day was rainy, but 42 were present. On the second Saturday, 72 out of 87 who had accepted the invitation were actually present and made the tour of various buildings.

Pandora Is Growing

When Pandora, our young giant panda, was being held in Chengtu, Szechuan Province, China, last May for shipment to the United States, she weighed approximately 24 pounds. On arrival at the Zoological Park in mid-June, her weight was recorded as 34.98 pounds. During most of the summer a weekly record of her weight was kept, showing an average increase of more than 2 pounds. During the fall, however, she became too large to handle comfortably and her weight is taken only once a month. The November 15 reading was 95.92 pounds. Experience data is still lacking to show how large a female panda will grow, but it seems likely that Pandora will reach her full size at a weight of about 200 pounds.

PUBLICATIONS OF INTEREST

ZACA VENTURE. By William Beebe. Harcourt, Brace and Company. $3.00.

Tired nocturnal readers who choose to wander in far-off seas just before turning off the light might miss the "*Zaca* Venture" by assuming that the Gulf of California, where sportsmen hook big sailfish, is too near the U. S. A. to be very strange or mysterious. But experienced readers of William Beebe will not be deceived, for where Beebe goes mysteries are constrained by his power and come forth out of their hiding places; they confront us, grow sinister and then retreat softly into their holes like the ghostly eels in his nightmarish garden; but we are left with haunting memories of gray undersea phantasies among the dark volcanic rock of the Galápagos Islands. Then, craving more mysteries, we descend with the master into another world of shades; we wander or float among the "magic banks," glimpsing new monsters in the fog; we come back, like Orpheus but without Eurydice, and on another day we descend into the pallid paradise of the angel fishes, only to find it full of threatening but impotent shapes. Or on some silent Pacific evening in the afterglow we look quiety down, as from heaven, upon the *Zaca* beneath and consider its sentient animalcules—all intent, like the citizens of the sea-going cork, upon their own little affairs.

Hard-boiled unbelievers, knowing the author's almost Gargantuan capacity for discovery, may sniff at this pseudo-nostalgic background as they do at "Dunsany's bat" and other well-worn props and apparatus of the Beebean ideology. But let them not rejoice prematurely that the mage's hand is beginning to falter. For which of them, by taking thought or otherwise, could conceive, inspire, assemble, infuse, inform direct and maintain a second "*Zaca* venture"? Who but Beebe could integrate out of such widely diverse personalities so productive an organization for the acquisition and diffusion of sound zoological knowledge?

For the undeniable success of the expedition Beebe modestly gives first credit to the *Zaca* and her owner. "The *Zaca*," he tells us, "is a two-masted diesel schooner, painted black, one hundred and eighteen feet over all, with a gross tonnage of eighty-four; Templeton Crocker is her owner, tanned a pleasant ochraceous tawny, five feet ten over all, with a refined tonnage of about twelve stone. The two, in juxtaposition, with a hand-picked captain and crew, set themselves to aid and abet a scientific expedition." Elsewhere he notes that although the *Zaca* is a yacht, built primarily for pleasure and comfort, it would be difficult to find a vessel better adapted for his kind of oceanographic work, which requires very slow hauling of the deep-sea dredges and quick stopping of the ship to prevent tearing of the dredge if the latter should hit a submarine obstruction. The *Zaca* also has a long cruising radius and is very seaworthy in severe storms. Nor does he forget the three members of his staff, "John Tee-Van, General Associate, Jocelyn Crane, Technical Associate, George Swanson, Artist," nor that "sleepless incarnation of the word Work," the Japanese artist Toshio Asaeda, nor the crew of diverse nationalities, who were "single-minded in their vital interest and furtherance of our activities."

Now that we have our explorer and his associates assembled it would be pleasant to follow them in their adventures as they cruised southeast along the Pacific coast of Lower California to its southern tip, Cape San Lucas, stopping at Cedros Island to study the great beds of floating kelp and finding therein a veritable world of kelp life; or observing the first dredge hauls of the expedition near the same island, which revealed rich areas of pure cultures: brittle stars, white-clubbed urchins, long-spined scarlet thorny-oysters, round, hermit-inhabited shells; each haul, as our author tells us, "deserved a day's study." Oh, how happy this reviewer could have been poring over the least of these *Zaca* treasure hauls! But time and space, twin enemies of lovers and reviewers, bid us pause. And for the reader himself the discovery of the joys of the "*Zaca* Venture" must be reserved.

By way of general criticism we may respectfully submit the following. During the past three decades Beebe has collected, handled, studied, identified and described, with infinite zest and efficiency, tens of thousands of invertebrates and vertebrates, representing hundreds of different zoological families. His numerous technical descriptions of new species of fishes and birds are models of clarity and precision and his long series of books, although written primarily for discriminating readers among the laity, are packed with illuminating observations of facts which no one of his professional colleagues could well afford to neglect. One would think that with his tide of productiveness still rising he could take an honest pride in all this and feel that he was building a constructive philosophy of zoology of his own. But the very magnitude, diversity and complexity of his discoveries have appalled him; he seems to meditate too often upon the depths of our ignorance which is called science, nor does he cease to brood upon the utter unimportance and insubstantiality of our vainglorious selves (as if such a lesson were needed by any half-intelligent person in the kind of world in which we are now living!). "Vanity of vanities, saith the preacher; behold, all is vanity." Thus he seems to be taking refuge in a pseudo-oriental, Spenglerian philosophy of frustration, which seems quite inappropriate to his ever dynamic personality and enormous achievements.

It is true that we see through a helmet-glass darkly and that we know only in part; but we have seen what we have seen, nor are we wholly without clues (called general principles) to guide us in this labyrinth of marine reality. Therefore, O William, we adjure thee, cast away this devil of negation. Go forth again and yet again upon new "Ventures," and may your argosies continue to bring home the treasures of the seven seas.

And, we may add, if you are too modest to generalize from your facts, your imprudent friends in the American Museum of Natural History will gladly take the risk.—W. K. G.

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No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

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NEW YORK ZOOLOGICAL SOCIETY

VOLUME XLII
JANUARY TO DECEMBER, 1939
Numbers 1-6

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

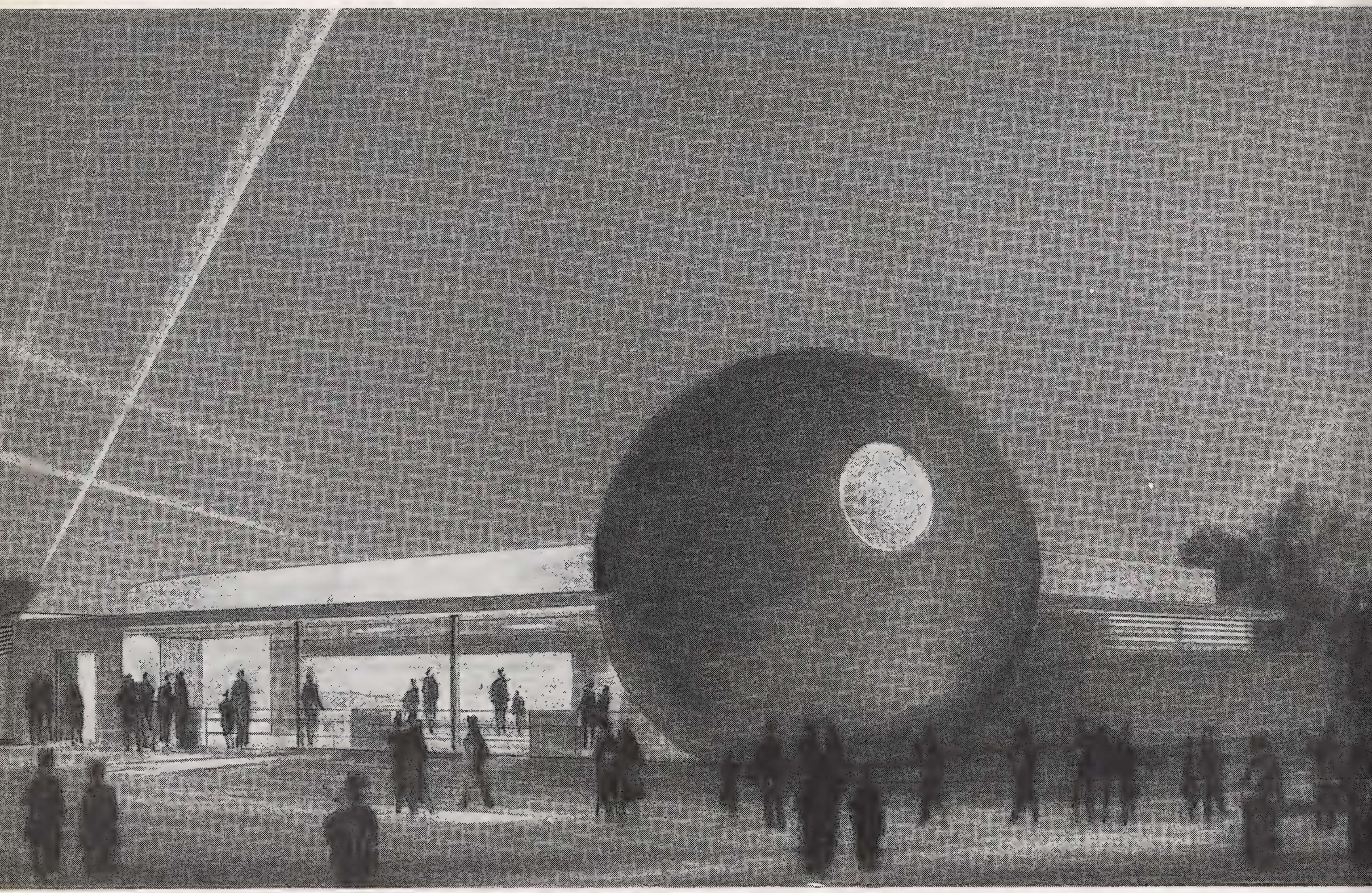
Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



Harold Sterner, Archi

This is the architect's drawing of how the Society's building at the World's Fair will look when finished. The entrance is at the extreme left; the great ball is a representation of the Bathysphere. Inside the ball the real Bathysphere will be exhibited in a setting recreating the depths of the ocean.

BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

Published by the New York Zoological Society

Vol. XLII January-February, 1939 No. 1

Our Building at the World's Fair

We Explore New Methods of Presenting the Wonders of Zoology so the Public Can Grasp Their Implications

FAIRFIELD OSBORN

THE entrance of the Society into the World's Fair provides a peculiarly fitting occasion for working towards certain objectives that we have had in mind for some time. Principal among these is the exploration and development of new methods of presenting the truths and limitless wonders of Zoology to the public.

We have a recurring thought in our mind—granting that its expression involves a play upon words—that we should become to the fullest extent possible an institution to which the millions of people who visit us each year will "come to see living things and go away with 'living ideas'." Our plans have not been motivated by any passing caprice nor impelled by any "join the parade" impulse. We hope, then, not only to find a proving ground for the ideas which we are working upon, but at the same time to provide an infinitely worthwhile experience for several hundreds of thousands of people who will look back upon their visit to our building as an original and inspiring experience which provided them with fresh concepts regarding the manifold forms of land and marine life.

We would like, among other things, to create a better understanding of the meaning of Time, of its essentiality in the development of life; we would like, for example, to bring to people's minds a clearer realization that all forms of life as we find them today are not merely this species or that species, are not, in a word, "just animals," but that they are, each of them, "characters" in a serial story, come to their present forms and natures because of the "plot" written through measureless ages in the past.

Man in the midst of modern civilization is apt to overlook the wealth of interest, and of drama too, that exists in the story of Zoology. Or is it because the story has only become clearer to science within the last century, and its interpretation to people as a whole is only now in process? The themes involved—many of them with analogies to the life of Man himself—are so arresting: the struggles for survival; the disappearance of the unfit—what a pathetic exit was that of *Tyrannosaurus rex,* in all his stupid majesty; the adaptations to environment; the social habits, individualism here, life for the community there; the migration of families from one continent to another!

It is our belief, in short, that there is a great opportunity for a scientific institution such as ours to develop better methods of presenting and interpreting the story of Zoology in a way that the man in the street can understand. For too long, scientific institutions of a public nature have failed to concentrate sufficiently on the invention of that particular alchemy which blends their knowledge-resources into the thought processes and comprehensions of the public. Too often the man whose primary job is the dissemination of scientific knowledge, keeps himself nevertheless in a sort of "Holy of

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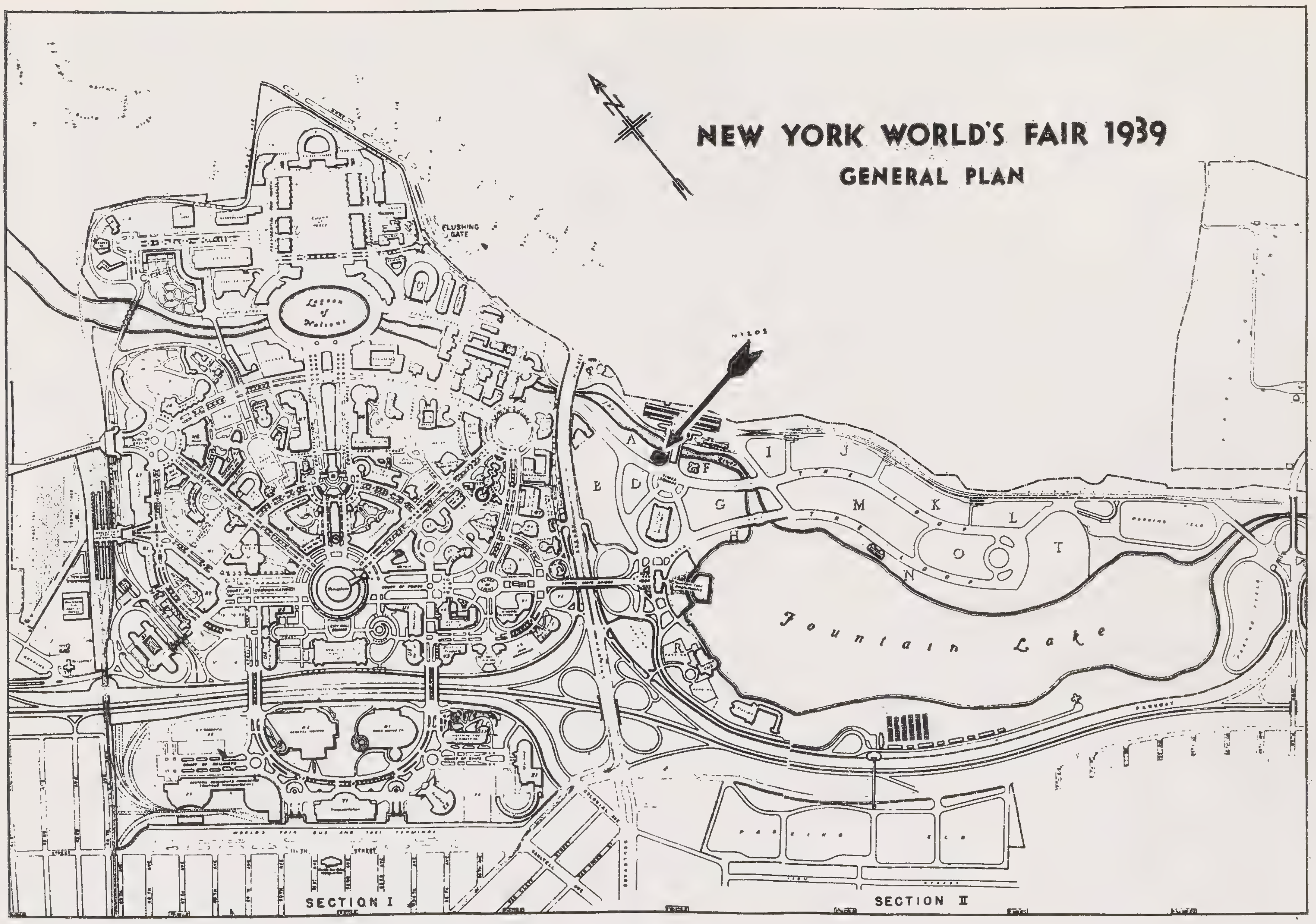
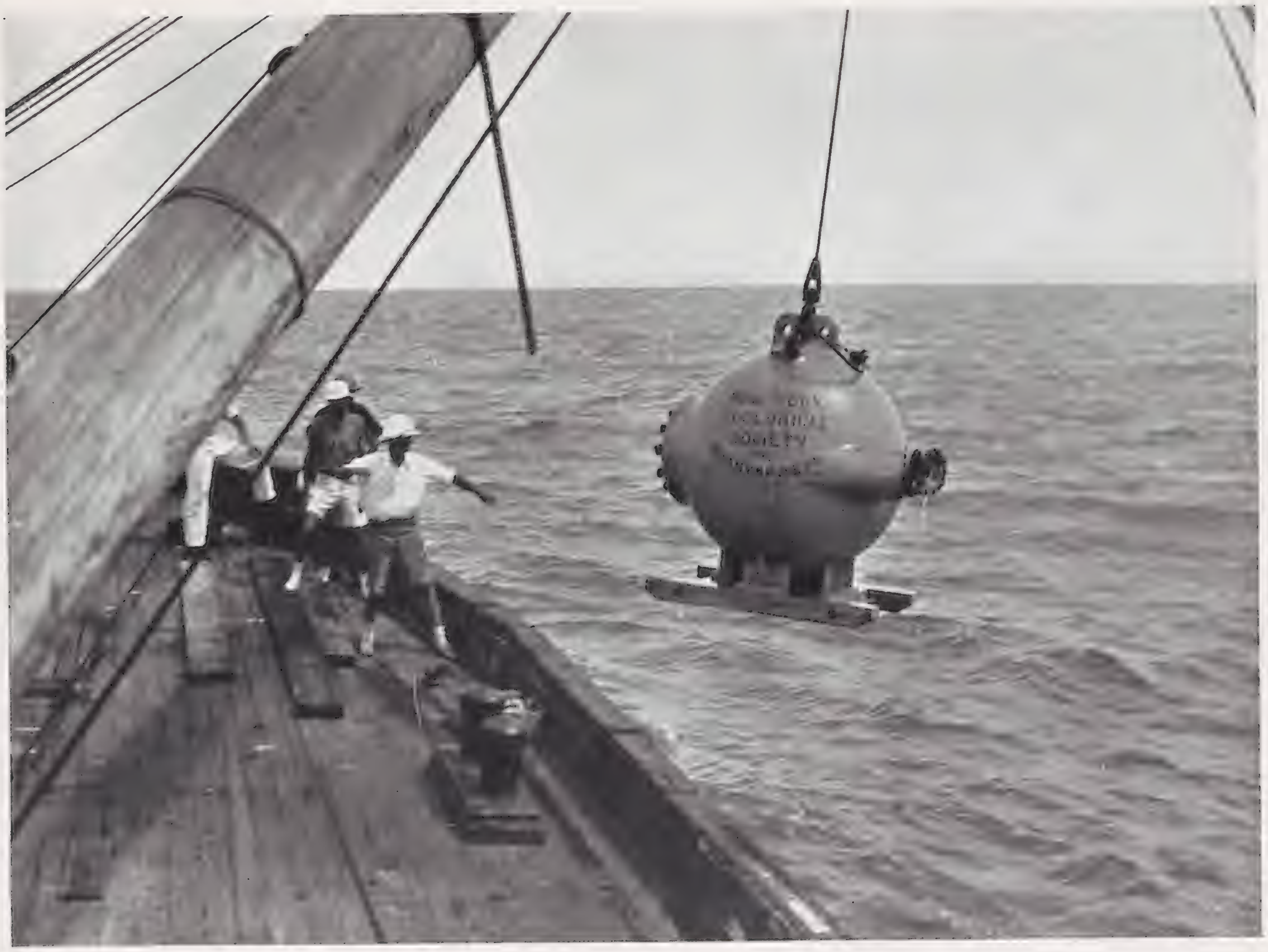


The black arrow points to the site of the Society's building. Directly alongside the terminus of the Independent subway, it faces "Times Square," one of the main orientation plazas in the section of the Fair devoted to entertainment, and is very near the center of the grounds.

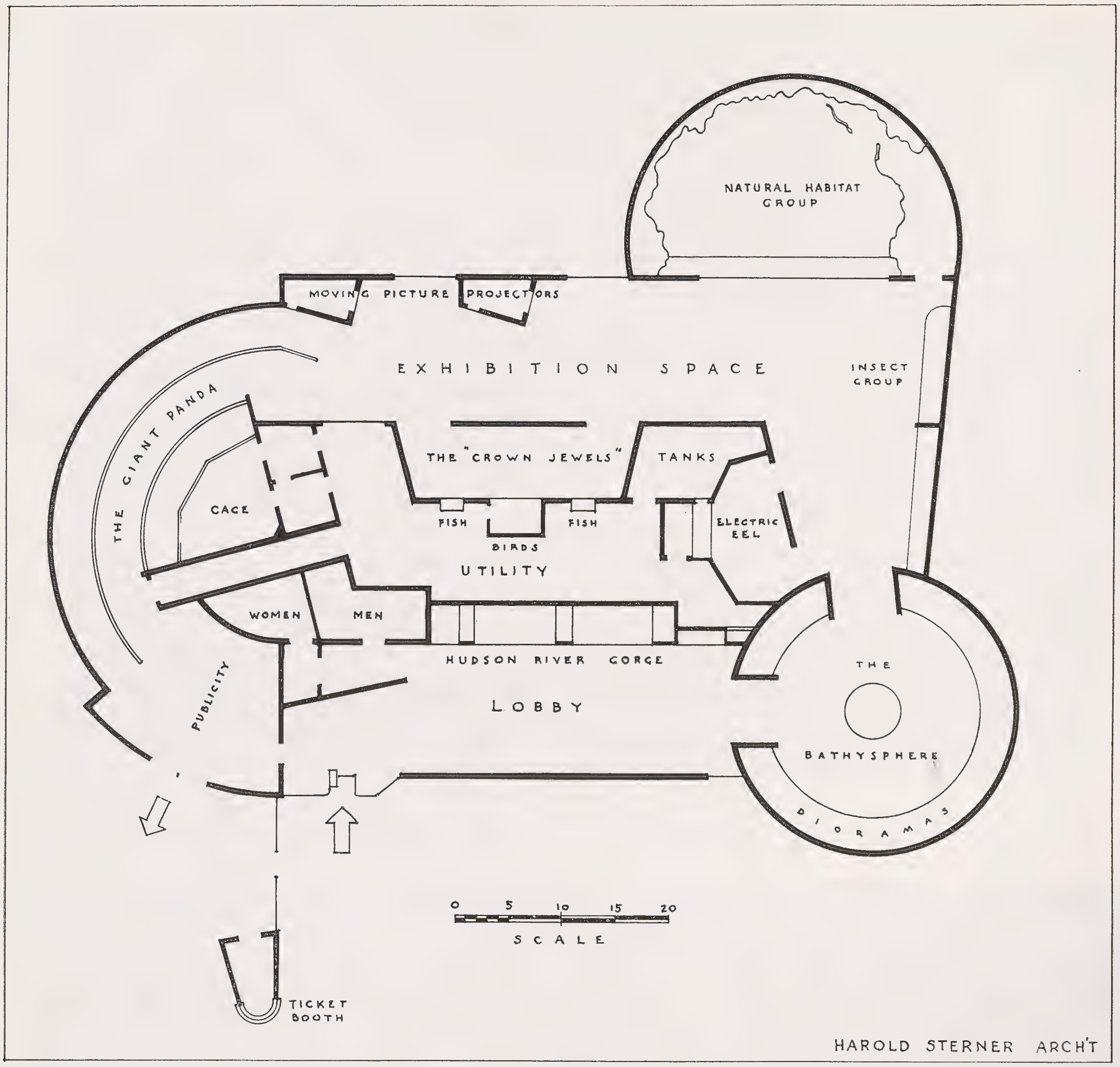
Holies", bulwarked by techniques, safe within the wire entanglements of Latin derivatives. True, the work of any institution in scientific research is the hallmark of its permanency and progress, and so the activities of this Society in this direction and in such matters as the conservation of wild life must go on unabated, but when it comes to the processes by which we can reach the public at large, we must further develop a language in which the listener, as well as the talker, may find pleasure and understanding.

With such general thoughts in mind, we are at work upon our World's Fair Exhibit. By no possibility, due to limitations of space in our building, can we do more than touch upon certain high spots in the story of Zoology. Also, we have come to realize that there is no use in our housing a zoological Rosetta Stone if no one comes in to see it, so we are placing lures in the path of the public—the Giant Panda, an exhibition of Electric Eels prepared to ring bells and flash electric lights, the "Crown Jewels" in the form of iridescent birds and fishes. But once the stranger is within our doors, he will begin to see and learn. Even the "lures" mentioned above will be in settings of documentary explanation — habitats, evolutionary derivations, social and life habits, migratory habits if any, and so forth.

The area upon entering the building will be dedicated to the theme of Time and its effect upon zoological life. The place will be completely and utterly familiar to everyone—none other than New York City and its environs. Because the Hudson River has majestically existed for many millions of years, its original gorge cut through solid rock, now submerged and extending one hundred miles easterly and terminating in the abysses of the ocean bed, this river history will be used as a Time theme. Consequently there are to be two large dioramas, the first representing the New York area, with certain animal forms known to have existed there-



Two of the main exhibits in the Society's building. (Top). The Bathysphere, swinging up from the cold and sunless depths off Bermuda. (Below). Pandora can be counted on for lively antics.



Architect Sterner's drawing of the floor plan of our building shows its compact arrangement. Provision has been made for representing more or less fully all phases of the Society's work, mostly by living exhibits with automatic motion pictures continuously supplementing them.

on, as it was approximately one million years ago; the second, showing this same area as it is today, but in this case including the marine forms, curious and little known, living in the ocean depths at the terminus of the Hudson River gorge. This exhibit will tie up with the deep-sea explorations and researches of Dr. William Beebe, Director of our Department of Tropical Research, which he has so brilliantly prosecuted. The "Bathysphere" in which he made his descent of more than one-half mile into the ocean depth will be on exhibition, as well as specimens and models of some of the rare and interesting species of deep-sea fish.

We shall then exhibit certain striking examples of particular adaptations which nature has developed, among which will be the following:

The Electric Eel, with an explanation of how its electricity is generated and used. It should be noted that the staff at the Aquarium has been conducting original researches into the organism of this curious animal, which has baffled scientists ever since the days of Faraday.

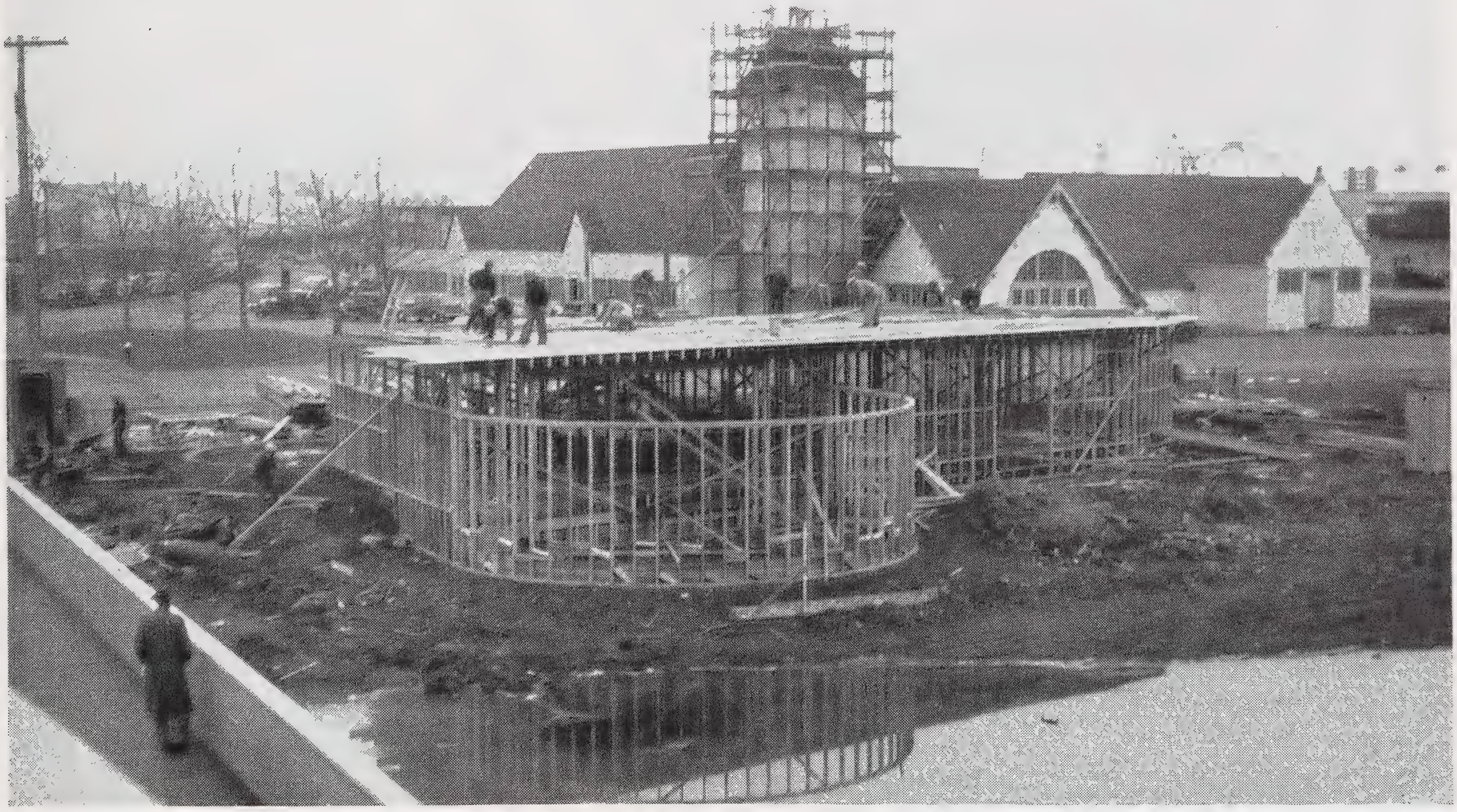
One of the exhibits which fascinates those of us who are working on its presentation is that of the so-called "Crown Jewels" of nature, and here we will show some of the most brilliant species of birds and fishes, gorgeously hued, iridescent as to feather or scale. And then by contrast, a group of animals that are colorless, scarcely visible to the eye against their natural background. How were such forms derived and by the impulse of what structural growths do we find brilliant color on the one hand and a total lack of it on the other?

There is also to be an exhibit of insect life, with which the Society has but casually dealt in the past. This form of life is so complex that an idea of its many manifestations may be gained from the fact that there are approximately 15,000 species found within 50 miles of New York City. When it comes to the diversities the world over, these are measured by more than 500,000 known different species, ranging in habitat from the snowy slopes of Mt. Everest to the silent shores of a tropical sea.

We shall have "Pandora", our Giant Panda, who, by the way, since arriving at the Zoological Park from Cheng-tu last June, has flourished amazingly. This curious animal from the interior of China is, as you are aware, a distant cousin of our American Raccoon. Her personality has already made her a great favorite with the public. In this case, as an illustration of the technique we are working upon in showing living animals, we shall do more than just exhibit "Pandora"—we shall attempt to tell something of the life of her species, conjecturing if you will as to her original evolutionary associations millions of years ago.

There will be installed also in our building automatic moving picture projectors with a series of films ranging all the way from pictures telling the story of the development of the embryo Eel, to the evolution of the lizard into a bird, and other representations regarding land and marine life. Before one leaves the building, one will come to a room devoted to information regarding the Zoological Society, its activities and its objectives for the future.

Before concluding, a word as to finances. The costs of the construction of the building and the installation of the exhibits are being met by the financial cooperation of a number of the



And here is the building in progress of construction. The view is from the rear and the semicircular wall is that of the natural habitat group which is shown at the top of the drawing on the opposite page. Since this picture was taken, the building has been almost completed.

Trustees of the Society. The actual administration of the enterprise is to be carried out by a separate corporation formed for that purpose. An admission charge will be made, so that it is hoped that the project may at least be self-supporting, if not actually returning a net residue which, if realized, would be added to the capital funds of the Society. Not the least interesting phase of this whole project will be the determination as to how an enterprise devoted primarily to scientific and educational purposes fares in competition with "shows" designed solely for profit-making purposes.

We are proceeding on the general premise that a public institution such as ours prospers and grows with its service to the public. We are admittedly on the search for new methods of bringing before the public the wonders of Zoology. We believe that there is an opportunity for leadership in this new field of action, and we only hope that we may do some justice to the possibilities that lie open to us.

Some Incidents in the Life of a Baby Orang

Finally the Great Day Comes When "Mike" Is Bathed and Groomed for His First Appearance on Exhibition

William Bridges

MIKE was a specimen, but that was about all that could be said for him when he came to the Zoological Park last July 2. He was a specimen of assorted diseases, amoebic dysentery and dermal mycosis being the chief ones.

Mike came from North Borneo by way of Dr. Adolph Schultz, Johns-Hopkins University and a New York animal dealer. At Johns-Hopkins he had made his contribution to science as a subject of experiments in primate psychology, but he was hardly in condition to contribute to the appearance of our primate collection when he reached the Zoological Park. None of his diseases was necessarily serious, but they required treatment, and Mike went to the Hospital.

A baby orang-utan—Mike was between three and four years old—is a gentle and tractable creature, as trusting and affectionate as a human baby. He took his medicine with only minor objections, and within two weeks his dysentery yielded to treatment. The mycosis that made most of his hair fall out and left his skin harsh and rough, required longer treatment but in time it too disappeared. During this time he acquired a great liking for a rubdown with baby oil every other day. Stretched out on the Hospital operating table, he relaxed completely while the oil was being kneaded into the skin of his back and neck and head. The attendant's fingers generally wore out long before Mike's patience.

Diet was a problem. Apparently Mike had been fed almost exclusively on bananas and milk; at any rate, those were the only foods he would accept readily. And the milk had to be served just so, in a bottle with a nipple.

It took literally weeks and a store of patience as great as Mike's own to teach him that there were other foods suitable for a young orang, and other ways of drinking milk. By fall he was in blooming health and willing to eat anything that was set before him. From a banana-and-milk diet Mike had learned to accept a daily menu that included:

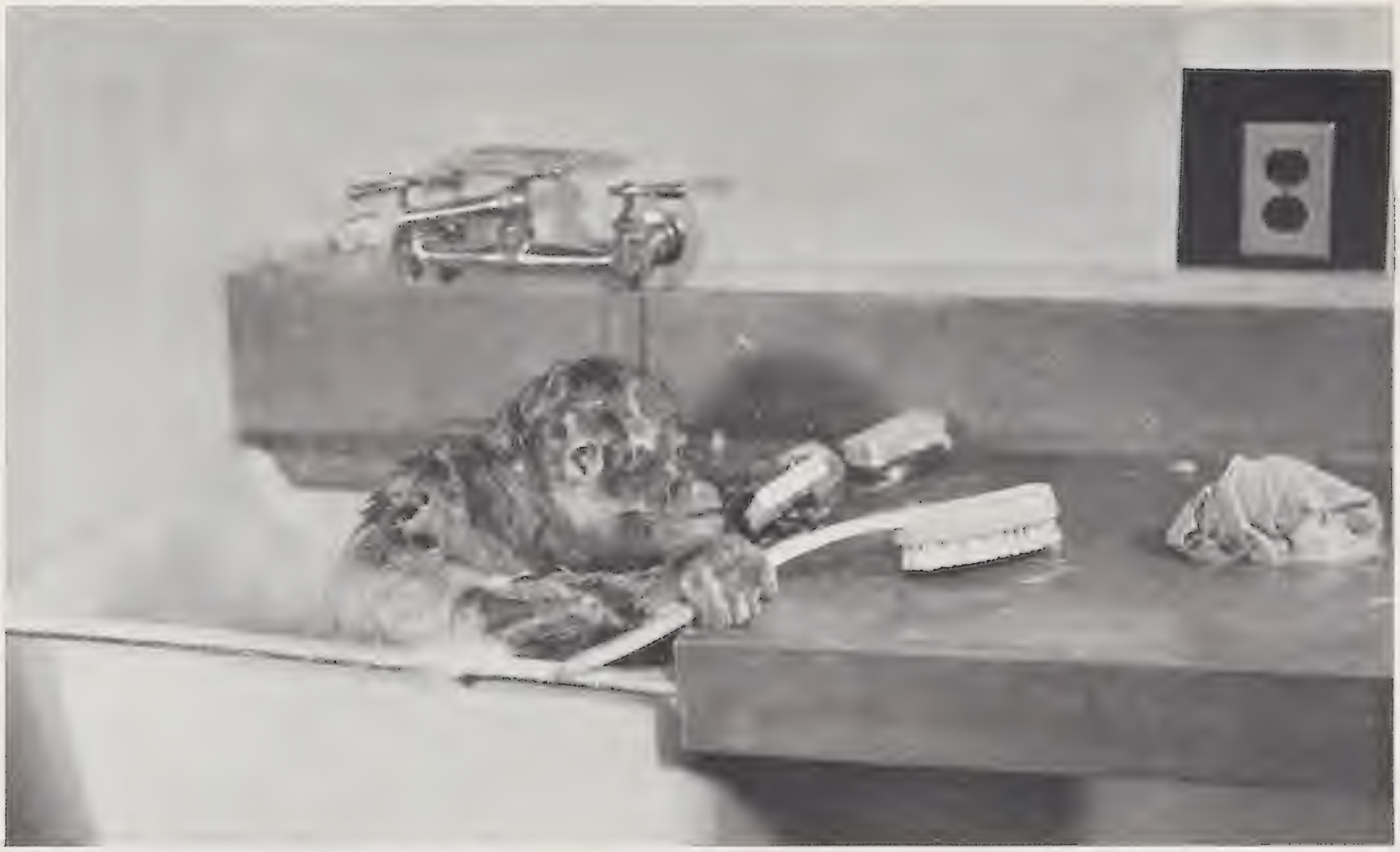
Bananas
Apples
Oranges
Cabbage
Carrots
Lettuce
Prunes
Apricots
Raisins
Celery
Rice Pudding
Milk (out of a regular milk bottle)
Pablum
Bread
Codliver Oil
Bone Meal
Iron Salts

And in addition the Hospital attendant, Herbert Knobloch, brought him a corn muffin and half a bar of milk chocolate every day!

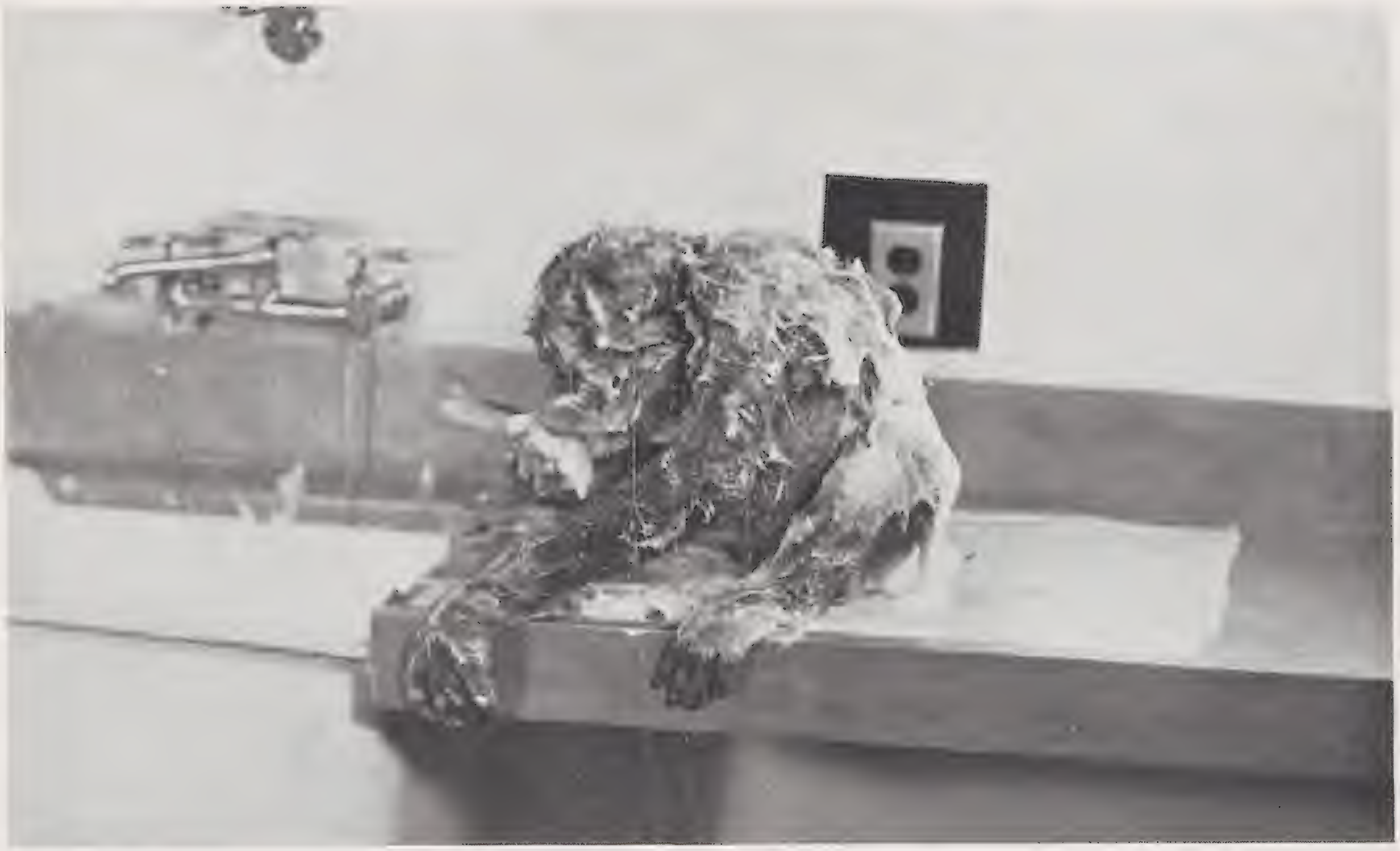
But Mike could not stay in the Hospital forever. He was healthy and vigorous—a proper zoological specimen. Late in January he got his final bath in warm soapsuds, his last luxurious rubdown with baby oil, and now he is on exhibition in the Primate House. The pictures that follow were taken by Mr. Osterndorff on Mike's last day in the Hospital.

1. Mike really enjoys a bath.

2. He is cooperative, too.



3. Soap deserves close inspection.



4. It might even be good to eat.

5. But the bath must go on.

6. Rubdown with baby oil comes next.

7. Contentment.

8. Luncheon is prepared.

9. The milk course is first.

10. It begins to disappear.

11. Looking back, was it fun?

12. Yes, definitely it was!

Fish with Super-brains

Primitive Mormyrids at the Aquarium Have Cranial Capacity Relatively Near that of Man

Charles M. Breder, Jr.

IN THE rivers of north and central Africa there lives a remarkable group of fishes not to be found anywhere else in the world. These comprise a single family, the Mormyridae, and are the possessors of some of the most extraordinary features to be found in all of fish life.

The ancient Egyptians knew them well and representations of certain of the species are not uncommon in their temple decorations, especially in association with Osiris and Isis. When Set dismembered the former, some pieces were cast into the Nile, and one was seized upon by a long-snouted fish—a mormyrid. By eating the bit of flesh, the fish took on some of the god-like qualities of Osiris and was thereafter venerated and protected against use as a food.

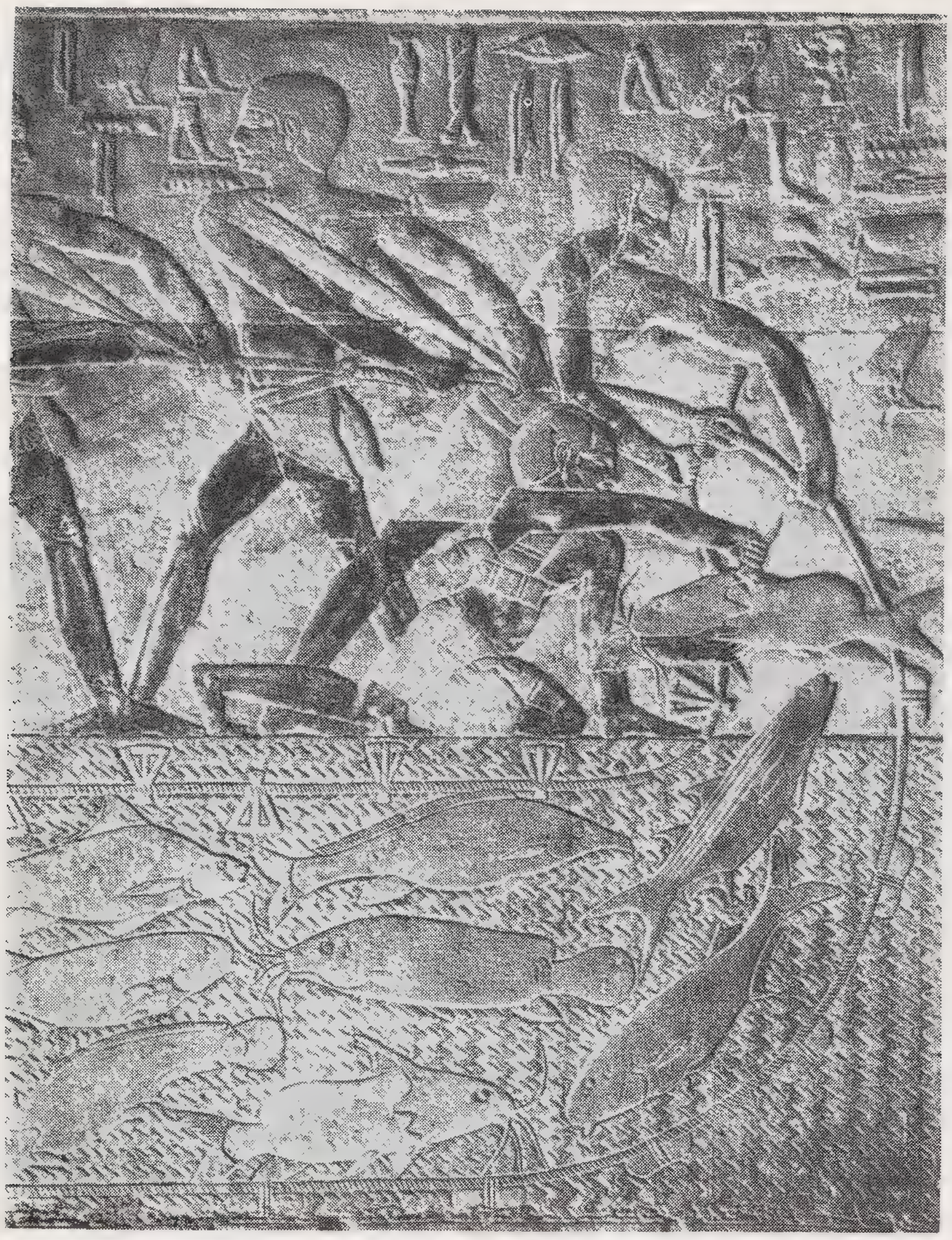
Our interest in mormyrids today, however, has little to do with the mythological attributes given them by ancient people of the Nile valley. These fish do not have to nibble on bits of the gods to seem remarkable to us. They have sufficient arresting features in their own right.

In a normal man of about 150 pounds, the brain will weigh about three pounds, about 1/50 of his total weight. Similar proportions are found in the higher anthropoids and, strangely, also in the squirrel monkey. Other animals show only tiny fractions of this proportion. In fact, only in such creatures as elephants and whales does the brain attain anything like the absolute weight of three pounds, and in these instances, since the rest of the animal is weighed in tons, the ratio comes down to very small proportions. Like other animals, fishes have a relatively very small brain—except in the case of the remarkable mormyrids. Here, in those species that have been examined, the brain weighs from 1/82 to 1/52 of the total weight of the fish. In other words, these remarkable fishes have brains directly comparable in weight to those of man and the higher apes!

This is a state of affairs that would pique the curiosity of almost any one, be he naturalist or not. What in the world does a fish, and one in the more primitive groups, at that, do with a brain of such a size? How is it that all the other fishes get along so well without anything comparable to that mass of tissue in the central nervous system—a condition which does not put in an appearance again until one gets to the highly developed mammals? Why has there not been a great deal of experimental work done to find out just what this peculiar development is all about?

Only to the last question can we give any semblance of an adequate answer. In the first place, the fishes live in regions that until recently have been fairly remote from active centers of modern scientific work. In the second, they live, for the most part, in extremely turbid, opaque waters in which observation is all but impossible. Furthermore, they are so extremely sensitive to handling that few have ever been transported alive any distance from their native habitat. A few specimens have been kept in the tanks of the Gezira and Berlin Aquariums, but nothing of note was learned about them.

For years we at the Aquarium have been trying to get some but had almost given up hope. We would jest about these "brainy" fellows being too neurotic to withstand the journey from Africa. It is consequently easy to imagine our delight when a shipment of mixed fishes received by the Paramount Aquarium Company was found to contain four mormyrids of one species. Just how they got here does not seem to be too

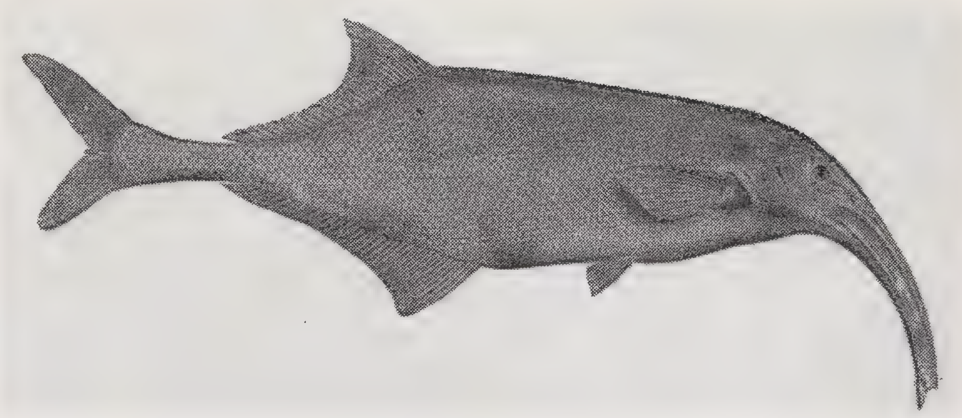


Metropolitan Museum

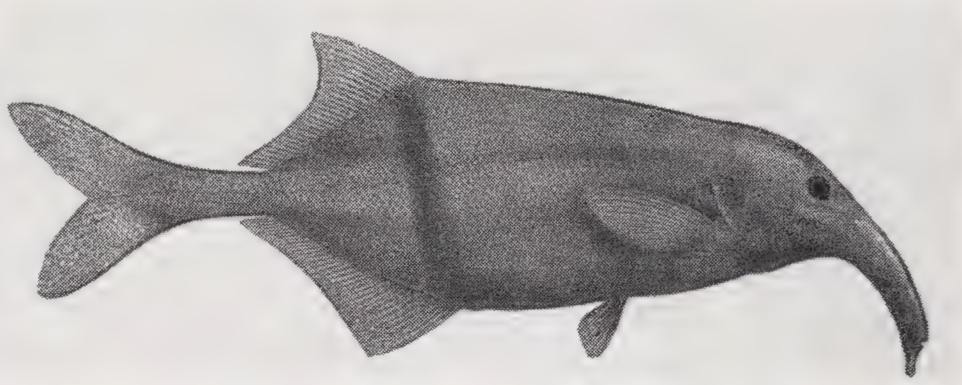
Bas-relief from an Egyptian tomb, showing fishermen at work. The fish at left center, top center and right bottom are Mormyrids; those with "whiskers" are catfish, and the one leaping from the water is a mullet.

clear in anyone's mind. One died shortly after arrival but the other three are still with us and seem to be accommodating themselves nicely to New York life.

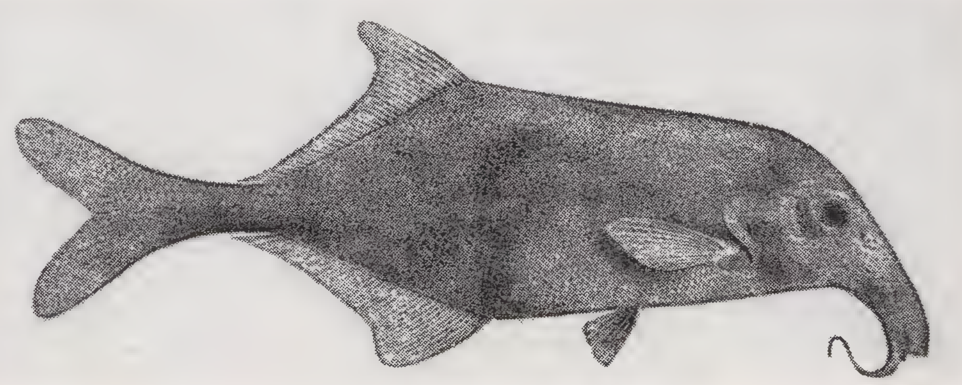
In appearance this species is not much to look at. It is of simple "fish" form, of plain silvery coloration, with small eyes, a small mouth and a rather swollen head. A number of mormyrids that I knew only from illustrations always puzzled me—I wondered whether the pictures were poorly drawn or whether the fish really did look like that! Now, looking at our own specimens, I realize that the illustrations were correct. The fish itself looks, to me, more like a child's crude drawing of a fish than like a real creature.



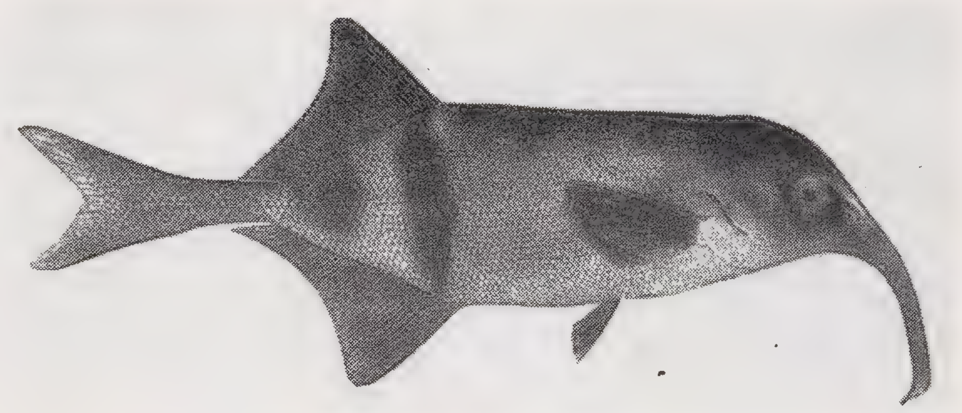
Gnathonemus curvirostris.



Gnathonemus rhynchophorus.



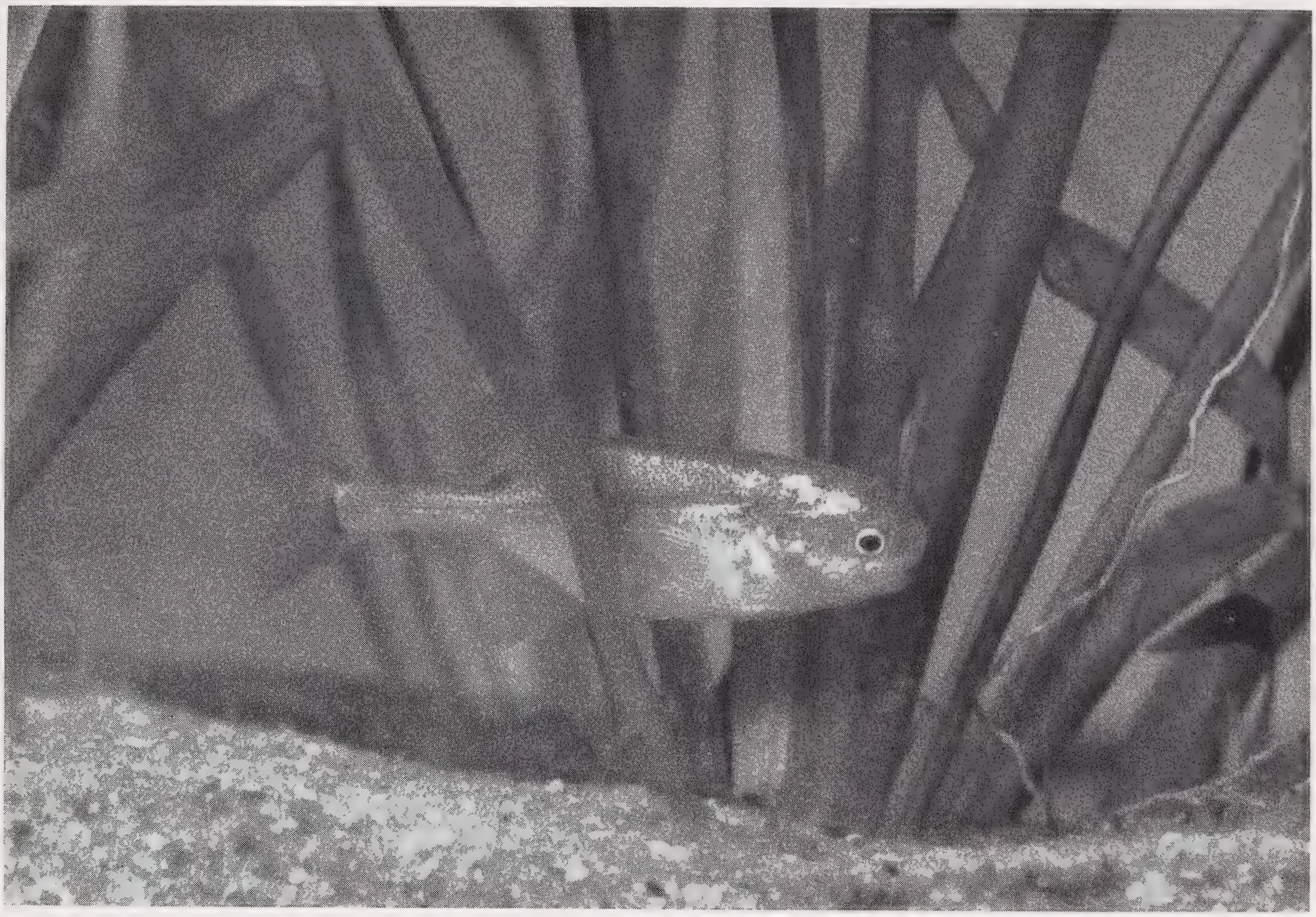
Gnathonemus mirus.



Gnathonemus ibis.

Four of the more remarkable forms of the African family of the Mormyridae. From Boulenger's "Fresh-water Fishes of Africa"

Although from the standpoint of behavior and habit we know virtually nothing about the typical mormyrids, the ever busy anatomists, who to their good fortune can be content with pickled specimens, have given us a considerable store of structural data on which we may base inferences and obtain leads as to the probable function of this or that detail. As a result of this we know that the sensory lateral line system of these fishes and their auditory apparatus are highly developed. Correspondingly, areas of the brain associated with those sense organs are the ones most highly developed. This does not lead us anywhere in particular, however, for catfish that have a rather similar development of sense organs and brain regions, nevertheless get along splendidly with a tiny brain. One might say that the details are all there but on a much smaller



This is the first mormyrid to reach the United States alive. Here it is shown resting among the vegetation in the bottom of its tank, in a place it has established as its own. The picture is a little larger than life-sized, and shows well the peculiar shape of the head.

scale. Catfish, moreover, manage to exist on every continent whereas the mormyrids are found only in Africa. It should not be assumed that I mean to attribute any greater mental ability or higher "I. Q." to these fishes than to others; all we have to go on is a great hypertrophy of the brain, and frankly I cannot at this time give any reasonable hypothesis as to its possible signficance. That, of course, is just why these fishes are so interesting! If a plausible guess could be made, offhand, as to what it is all about, I am sure our interest in the fish would not be so great.

The species we have at the Aquarium is either *Marcusinius kingslayae* or something very close to it. In any case, it is unknown except as to descriptive details. Thus far we have been able to learn from observation that the fish are extremely nervous in disposition. Sudden movements cause fright and hiding. When apparently at ease the tail and pectoral fins quiver constantly, even when the fish is not swimming. Respiration is accomplished by a movement of the gill covers that is so rapid that it can only be described as a flutter. After being for only a few days in an aquarium provided with some rocks and plants, the individuals set up territorial rights. This was not expected in a fish of this sort. It seems that each fish moves more or less over a given "beat," browsing along for bits of food, and if a second one strays into its territory the owner chases the intruder off, back to its own territory.

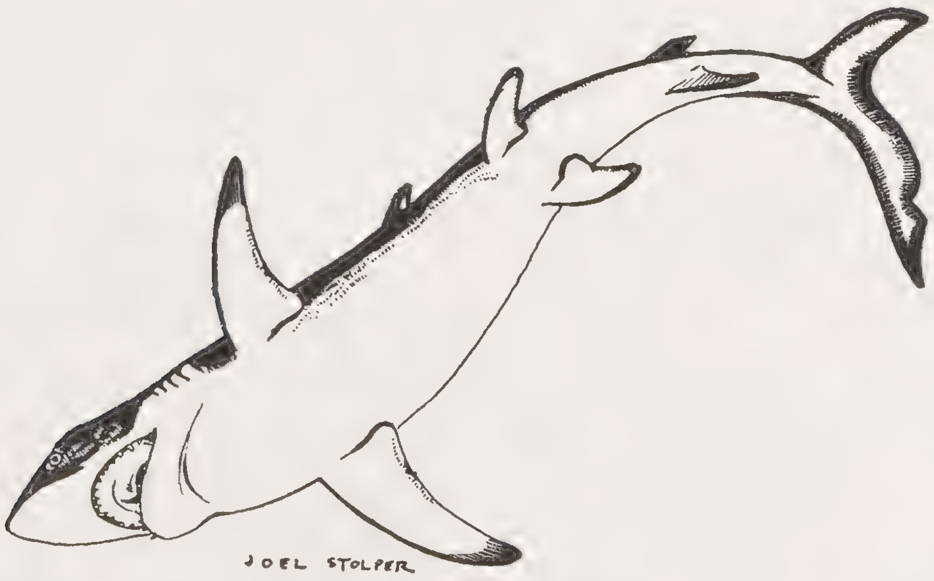
This movement over a regular route was expected to aid the photographer in taking pictures. It so happened that one of the fish habitually passed between two rocks that were fairly close together. The photographer moved the two rocks too close for the fish to swim between them, in order to change its route. However, this did not work because, when the fish discovered that it was unable to pass between the rocks readily, it resorted to the expedient of burrowing a trough in the sand below them, creating a passage that enabled it to restore its normal route.

These few notes virtually cover our observations on this species at the present writing. We would like to have them reproducing before any chances are taken with them, and for this reason we have been forced to disappoint our visitors by not placing them on exhibition. As it is, nothing whatever is known of the reproductive habits of these strange creatures. Samuel Budgett, who at the turn of the century was doing pioneer work on the habits of other African fishes, described the nest and eggs of some species he thought to be a mormyrid, but subsequently it was established that this nest belonged to an entirely different group of fishes. He did, however, study the nesting habits of an eel-like offshoot of the mormyrids, *Gymnarchus*. This creature builds a large floating nest of aquatic vegetation.

The family Mormyridae is composed of about one hundred species. A good many look not unlike the one we have here. There are others, however, which are decidedly spectacular, possessing an elongate and decurved snout that has earned for one species the name "elephant fish." It was this one that the ancient Egyptians liked to draw. Actually, the decurved snout is more like that of an anteater, in that it is rigid and the small mouth is at its end. To add still further to the peculiar specializations of the mormyrids, there are some that have feeble electric powers.

We have, then, this picture of these fishes: living in the nearly opaque, muddy waters of the Nile, their eyes are small and probably not very important to them; their lateral sense organs, their ears and brains are highly developed; their face may be short and fat, as in our species, or variously long and pulled out and decurved, and they may have electric powers. Supposedly our type of mormyrid was derived from one of the long-snouted types and had its face secondarily shortened. This is argued by anatomists on a basis of the arrangement of the bones of the skull and means that although our particular species is a very ordinary-looking fish, it actually has an ancestry that can be traced back through the weird, long-snouted forms.

We hope to learn many things of interest concerning the manner of life of these fishes, from these three now living at the Aquarium. Better still would be carefully planned field work in Africa where we might study large numbers of individuals and kinds in their native habitat. Eventually, if this could be carried out, we would look forward to finding out enough about them and their needs to be able to establish an exhibition of some of the more fantastic kinds. For while our present ones are queer, they are hardly spectacular, and some of the other species are certainly odd enough to make the most blasé New Yorker emit a gasp of surprise. And then, we do want to find out about those large brains!



Ghost Beach is a quiet strip of sand on the shore of the Bay of Honda, one of the forty bays visited by the Eastern Pacific Zaca *Expedition. Here, when the tide goes out, hundreds of crabs crawl out of their burrows and run down the beach to feed on the tidal detritus.*

The Painted Ghosts of Honda Bay

Silently They Emerge in the Sunshine, and the Faint Movement of a Sigh Will Exorcise Them

JOCELYN CRANE

THE very first ghost I saw at Honda broke the primary rule of proper ghostly conduct. Instead of waiting for an eery midnight, it appeared on that tropical beach in the full blaze of mid-morning sunshine. In spite of this eccentricity, however, it did materialize with due suddenness. One minute the entire stretch of pale sand was smoothly empty; the next the ghost was there, a sagging, sand-caked little figure, leaning its head dejectedly on three elbows.

Ghosts, whether crab or human, are notoriously wary, so, from my station under a coco palm, I picked up the binoculars and trained them on the present apparition with the deliberation of an athlete in a slow-motion picture. Even so the vision vanished completely, though it had stood a full twenty feet away, and did not reappear for another ten minutes. This time, his fears quieted, he began the serious business of a ghost crab's day on that Pacific beach in northwest Panama, and every detail of his activities showed clearly through the glasses.

Even though I could now see the neat, two-inch-wide hole from which he had emerged, his method of arrival remained remarkable enough. During the preceding three or four hours the crab, though normally an air-breather, had been buried in fourteen inches of sand while the high tide surged above him. Then, when the waters receded, he had somehow dug his way up through the damp sand, compressing it about him until at last he emerged into the air and sunshine, leaving a clear passageway behind and not marring the entrance with so much as an extra pinch of sand. No wonder the ghost was stiff and tired. It was as if a besieged Spaniard, after a long and devasting bombardment, should dig his way from a flooded cellar up to daylight, through a pile of crumbled bricks and mortar six full storeys high!

So there sagged the crab at the mouth of his hole; even his long stalked eyes, normally alertly erect in the air, slanted tiredly in opposite directions, the glassy gray lenses clouded with sand. Soon, however, with the help of the sun which dried the grains, he began his toilet, grooming all the complicated joints of his anatomy with the care of an eighteenth century dandy smoothing his frills before a mirror. Within fifteen minutes he was revealed in all his unghostly sunset glory of pigment, which the pallor of the surrounding beach set off to perfection. Above, his shell and legs were bright coral red, marbled with chestnut and gold. The delicate stalked eyes were rose, with pearl gray lenses from which rose wire-slim rods of pure flame-color—rods whose use we cannot even guess. The eye sockets, into which stalks and eyes fitted so closely when the crab was underground, now showed the pure orange of a Halloween pumpkin. As the warmth revived him, he rose ever higher on his slender legs until at last he stood poised on the very tips of his eight buff toes, showing his rosy underparts, and when he brandished his front claw-legs—the chelipeds—the pale gold palms and coral pincers flashed bright in the sunlight.

For almost an hour he stayed by his hole, regaining his habitual poise and energy. None of the other ghosts on the beach came near; practically all, being smaller than he, were already feeding down close to the edge of the ebbing tide. The larger the crab, the deeper the hole it digs at the approach of high tide; therefore, the longer the water washes through the retreat, and the later the crab emerges. Since the present ghost was the largest in sight on the entire beach, it followed that he was the last to emerge, preen himself and start the daily round.

At last the Old Ghost felt he had come into his full strength. Stretching himself still higher on his toes, he strolled a few slow steps sideways toward the water's edge, his eyes perfectly erect, more alert than before for danger, now that the safety of his hole lay well behind him. A few steps more and his keen senses told him of the presence of a dozen hermit crabs, swarming with vulturine activity over the carcass of a purple land crab newly washed up by the tide. But the ghost was no scavenger of such gross prey; he moved but six feet in the direction of the banquet, disdainfully twiddling his antennae to make sure he was missing nothing worthwhile, and then continued his phlegmatic, fitful progress toward the sea.

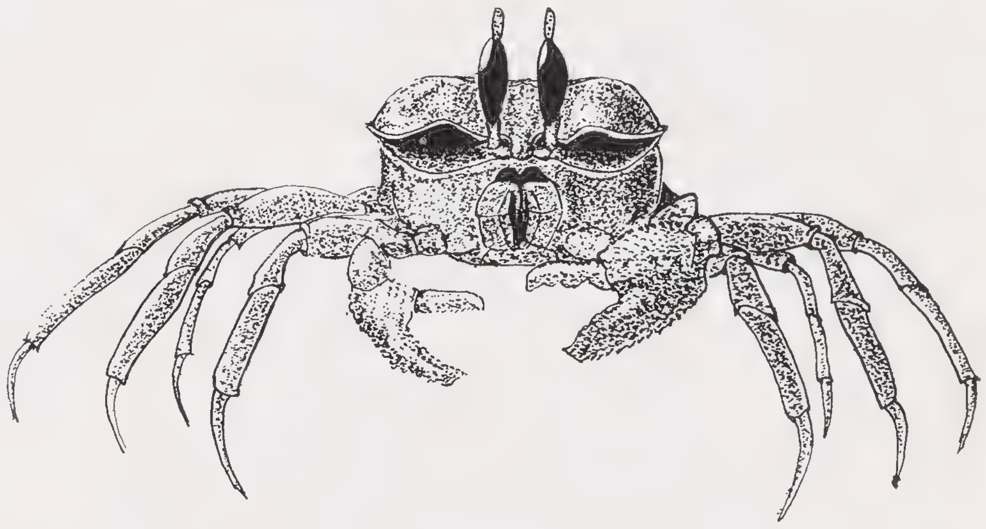
When the nearest of his fellows, who were feeding in hundreds on the fresh-wet sand, were only twenty-five feet away, he became suddenly aware of them, and of the splendid feast before him. Casting his grandfatherly decorum to the winds, he raced waterward with wonderful speed until he reached a vacant spot on the very edge of the tide. Then he fell to the day's real work of sifting minute bits of food from the sand newly fertilized by the sea, and turning the tiny particles into that complex piece of protoplasm which is a Painted Ghost Crab.

Meanwhile, one hundred and fifty feet higher up on the beach, a hermit, newly gorged on the dead land crab, bumbled along on his way to a daytime sleep in the cool of the jungle. His path took him close to the edge of the Old Ghost's hole, which he paused to explore with antennae and claws. He evidently approved it thoroughly, for, dragging himself and his heavy shell-house inside, he cuffed a stopper of loose sand over the mouth of the hole, as protection from the sun, and settled down for a restful day, like a night watchman borrowing an unused bed without asking the owner's permission.

The ghost crabs of Honda were proving to be among the most pleasant crustaceans we found on the *Zaca* expedition down the west coast of Central America. All crabs were exciting in one way or another; the great swimmers and spiders that came up in the deep dredges from the bottom of the sea; the daddy-long-legs-like arrow crabs that climbed over seaweed in the bays; the agile Sally Lightfoots of the rocks; the scarlet and black trapezias that called the coral reefs home; the hundred and one kinds of stone crabs of rocky shores and, above all, the fiddlers and their cousins which haunted the mud of the mangroves. I liked them all, but my affection for the ghost crabs was at the present time dominant, chiefly because—I confess—under my palm tree I could for a few hours give in to an attack of *hasta-mañana-dolce-far-niente* which was an impossible luxury when I was trying to spy out some of the life secrets of the other species.

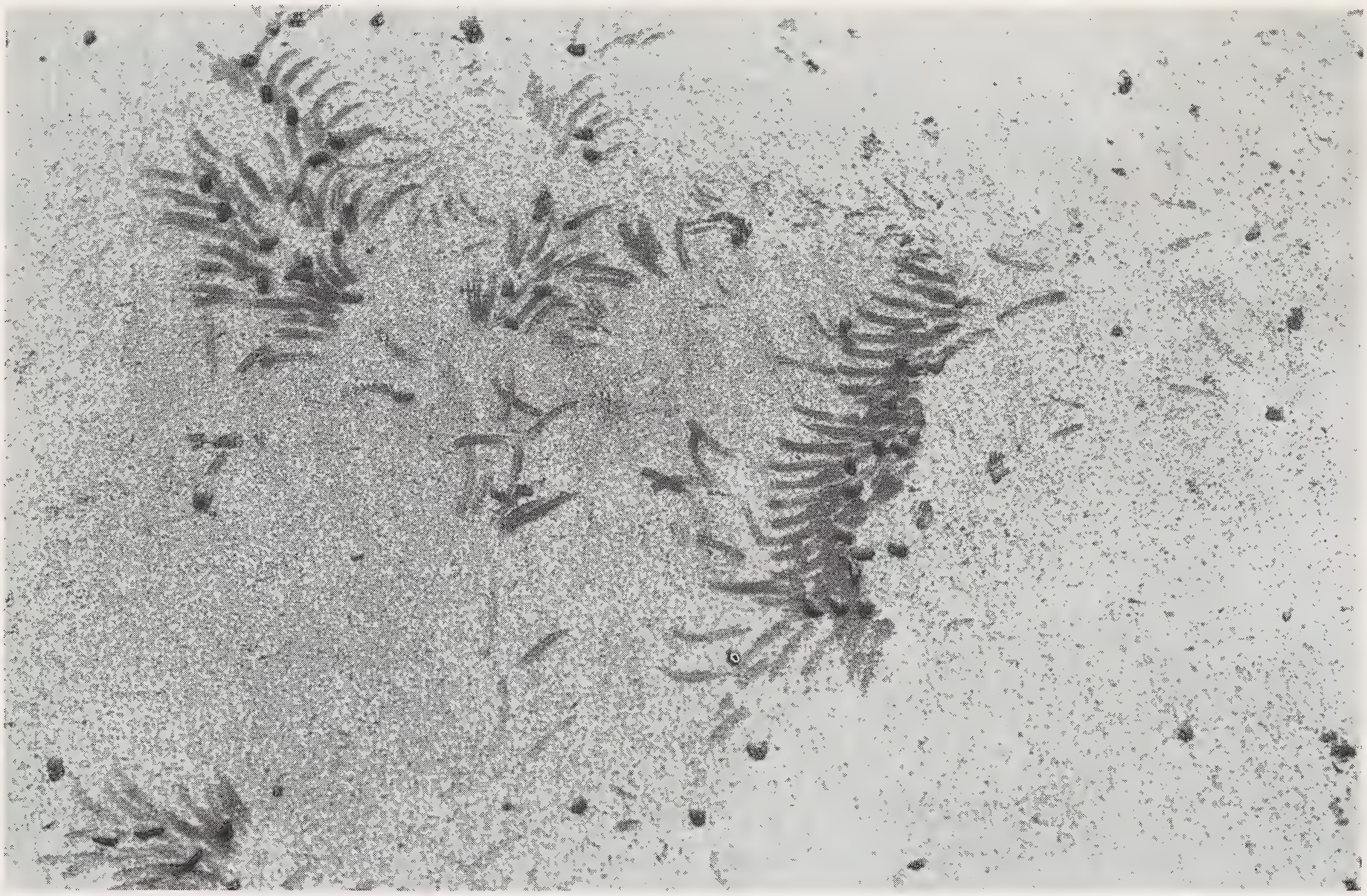
For example, crabs caught in a deep dredge had to be described, roughly identified, recorded, labeled and preserved—along with all the starfish, shrimps, seafans, and so on which came up with them—with as much speed as possible before a new avalanche of creatures poured into the sorting trays from the succeeding dredge haul. Similarly, coral crabs must be literally hammered out of their hiding places, after the great mass of amber coral had been brought up by diving and piled on deck; small bits had to be broken up, and every cranny explored for lurking crabs which would rather sacrifice several legs than loose their holds. Even then, once you got them out, there was little chance of learning any of their habits before preserving them in vials of alcohol; coral crabs, dredge crabs, and crabs that live under stones as well, all live lives discouragingly secret to curious scientists.

When we hunted the crabs of the mangrove mud, a wholly different technique was needed which required a peculiarly sticky kind of persistence. If you confined yourself to watching a colony of fiddlers, you must bake in the full sun of the mudflat, and become coated with mud which smeared itself relentlessly on notebook and field glasses; in the end you discovered that, though fiddlers more than rival ghost crabs in social organization, still they lack much of the ghost crabs' diversity of habits and sheer pep. No mangrove fiddler ever wanders far from his hole, and all vanish from sight at the least warning; none ever dances featherlight across the mud.



Furthermore, the catching of a really determined large mangrove fiddler is a feat. If you are experienced, you never even try to catch a rare specimen with a shovel; as you dug, you would expose such a large number of neighboring crab holes in your water-filled, incaving excavation, that your prey could readily escape unseen—if you missed cutting him in two by accident. Therefore, you go after him simply armed with a trowel and your two hands. Your first action is to wade up to your knees in mud toward the particular hole down which, long since, the fiddler you seek has retreated; then you get down on your knees; this procedure increases the amount of your surface in contact with the mud, so that you do not sink as rapidly as you did when erect; nevertheless, within a few moments your legs are quite buried, and you are literally rooted to the spot. By this time you have ceased to bewail your erstwhile clean shirt and shorts in which you are ill-advisedly clad instead of your bathing suit, and are wallowing as contentedly as a crocodile, thanks to the principle which makes you cease to mind rain, once you are thoroughly wet.

Your position settled, you discover you have left the trowel at the last crab hole, some fifty feet away across the mudflat. Back in place some minutes later, you find the trowel is no



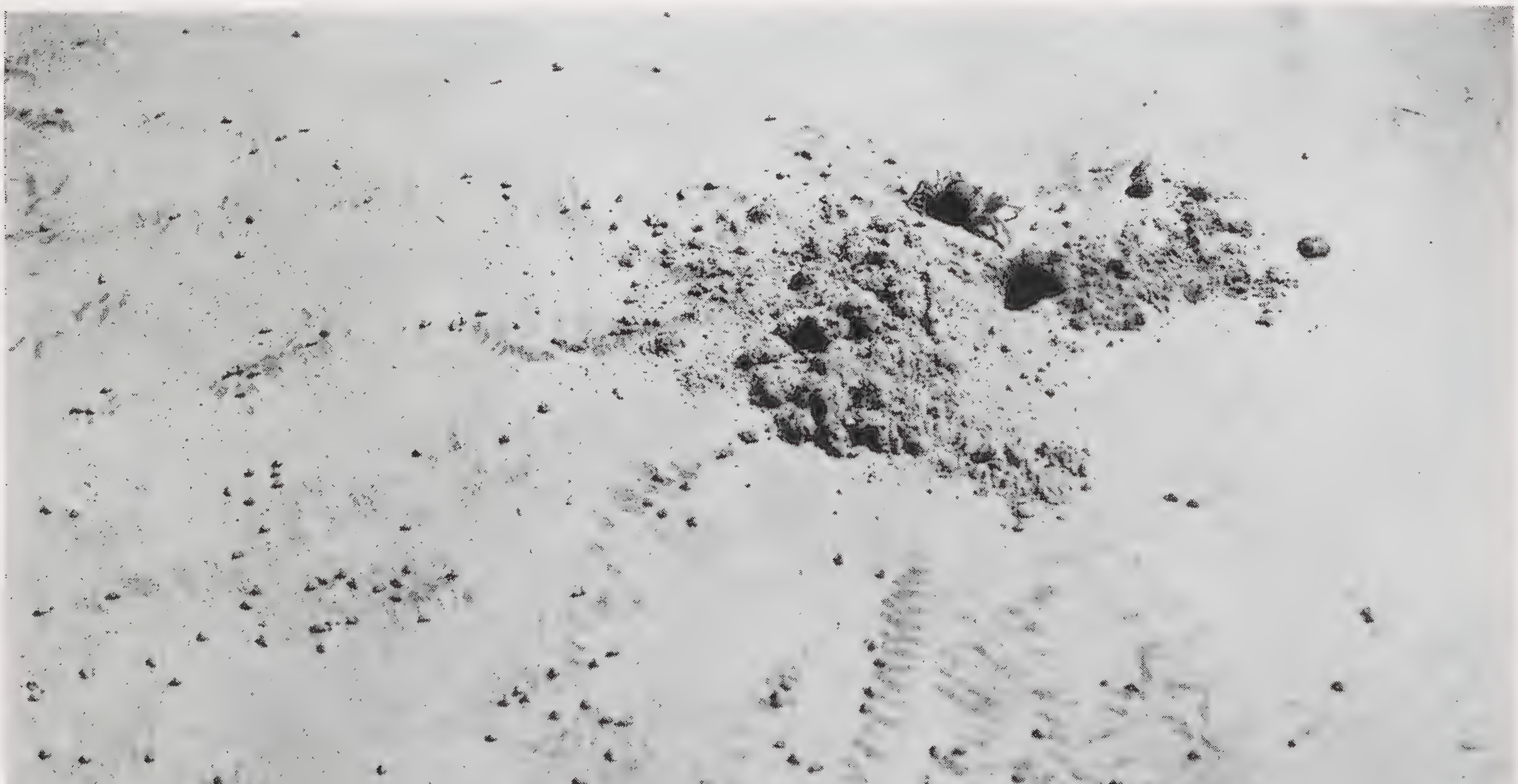
Claw prints in the sand. During the hours of low tide, each crab scoops up thousands of clawfuls of sand, mumbles them to extract the bits of animal and plant life, and then drops the remaining grains from the rear of its jaws in the neat little pellets that can be seen here.

use anyway, since the mud is so soft with the seeping tide that the sides of the hole cave in before you can take out the next scoop. So you grit your teeth and commence the honored Adam-and-Eve process of digging by hand. The first twelve inches are easy, since you can dig, dog-fashion, with two hands at once. After that, you leave your right arm in, worming it downward. Then a crook in the passage, contrary to the direction of your elbow's natural bend, complicates matters so that you must wriggle around once more; you wish vaguely that you could follow your prey *in toto,* somewhat like Alice descending the rabbit hole. Then you consider the effect a crab at bay might have on your enquiring nose, and are glad after all that only your hand must descend. You are by this time lying prone, face downward, to allow yourself the longest possible reach, and are literally biting the earth at the limit of your stretch, when your groping finger-tips touch something hard and smooth with a certain feel quite unlike that of the last stone you broke a thumbnail on; it can be only the fiddler.

You hastily retreat your finger an inch, pant a moment, gathering strength and courage for the final assault, trying the while to bar painful memories of the last time you caught a giant fiddler in your fingers, and do your best to feel the direction of his great claw: is he sitting sideways, or facing front? You make a guess, grasp him quickly and firmly, and all is well; you have the large claw pressed safely against his broad front. Then you start pulling while he digs in with all eight legs and tugs in the opposite direction. You pull again, and finally win; he is on the way up, in your hand. You call out jubilantly—and for one split second relax your aching fingers although he is still a foot from the top: instantly your thumb is gripped in a saw-toothed vice, your cry of victory changes to a wail of pain, and, although you do catch that crab, you remember for three days that the crab also caught you . . .

Yes, it was restful to be studying ghost crabs for a while—painted ghost crabs which are such cheerful, active extroverts leading frankly open lives (daylight lives, unlike their pallid, night-scurrying cousins, the Common Ghost Crabs), and which never dig holes in squashy mud and never make burrows more than fourteen inches deep, and which can always be captured in full flight, with a net, in spite of their speed. So I sat contentedly under the palm tree, with the binoculars trained gratefully on the crabs feeding at the water's edge, and between moments stared out at the broad curve of the uninhabited beach with the enchanting stretch of blue sea and green-thatched islands just beyond; I smelled the jungle, and heard the toucans calling just behind me, and appreciated ghost crabs as a subject.

The Oldest Ghost was now feeding, as though he had starved for a week, among the hundreds of his fellows on the very edge of the white band of foam. Using right and left claws alternately, he scooped up and placed in his jaws pinches of sand at the remarkable rate of four scoops to the second. Each pinch was mumbled in his bristle-fringed jaws, the minute particles of plant and animal matter somehow extracted, and the remaining sand, minus all nourishment, passed slightly backwards and dropped from the rear end of his elongate mouth in the form of a neat pellet, even as a fresh pinch arrived at the front. The pellets were discarded at the rate of two to the second; that is, the amount scooped by both right and left claws yielded one ovoid pellet of waste material, measuring a little more than a quarter of an inch in length. Since each crab put in at least six hours of actual eating between high tides, the discarded sand pellets of a single ghost—if laid end to end in time-honored statistical fashion—would make a chain more than nine hundred feet long! Inasmuch as there were more than twenty-eight hundred crabs on the beach, their combined mumble-mileages should give efficiency experts cause for admiration. Also, these sleek creatures that scoop up ordinary sea-sand, separate invisible proteins, carbohydrates, fats, salts and vitamins from it, and discard the waste to be reimpregnated with calories by the next high tide, should make every earnest social worker dream ruefully of evolutionary might-have-beens: If only all the



The Ghost Crab (Ocypode gaudichaudii) *rests at the mouth of the burrow in which it hides during the high tide. The marks of its claws can still be seen in the drying sand, and scattered over the surface are dozens of the sand pellets cast out from the crab's jaws.*

country's bread-lines could be wafted to Coney Island, sunk to their collective knees, and invited to feast on the fresh-washed sand!

About three hours before high tide the entire crab colony at Honda grew restless, made short rushes up the beach, returned to the edge of the surf for another snack, and finally began hunting proper holes for sanctuary during high water. There was apparently no sense of private ownership. The Oldest Ghost did not even try to find his last night's lodging, now inhabited by a hermit crab, but chose another farther up the beach. Since the new hole was quite a bit too small, he widened and deepened it to fit his robust figure; he would bring up a few clawfuls of sand at a time, and then stop to rest and feed around the mouth of the hole, leaving lovely patterns of pellets radiating in all directions. The holes of most of the crabs were in the uppermost sixth of the beach, since this region would be the last to be flooded, and hence give its prospective tenants a longer time to spend in feeding.

Only a few crabs—the last comers—had to dig wholly new burrows; thanks to the occasional hermit crab squatters, there were not enough holes to go round.

It has been said that these ghost crabs can be frightened into their burrows by the slightest noise. At Honda, sitting under my coco palm, I tested for myself the hearing of the crabs. Being careful to avoid any movement, I hallooed softly. Nothing happened; even the nearest crabs went on eating and digging and resting as usual. Then I whooped and yelled like the proverbial Comanche; still nothing happened. Then I whistled "Yankee Doodle" in several keys and various degrees of tunefulness. No answer. Finally, I gathered all my breath and yodelled the Song of the Valkyrie, and though that performance startled three macaws and two toucans into uproarious protest in the jungle, not a single crab even twiddled an antenna. Whereupon I heaved a sigh of exhaustion—and, at this slight movement, every crab within twenty feet vanished instantly. Sight, not sound, governs the ghost crab fears, and in seeing, they exercise discrimination: Hermits can touch them in passing, even feel them over, and the ghosts pay no attention; butterflies hovering just above the sand bother them not at all; yet the shadow of a heron—a natural enemy—sends them diving, and, as I have said, they will not allow a moving human being within twenty feet or a quietly sitting one within ten. The larger and brighter the crab, the greater his wariness.

As the tide neared full, the crabs one after the other vanished down their holes to stay, pulling a loose plug of sand in after them. An hour before high tide not a crab was in sight. Two hours more would elapse before the first, sand-caked ghost would emerge on the highest water-mark, limp and starchless as an old roué before his morning cup of coffee.

I rose and stretched, and noticed that a high surf had built up with the tide. Then I glimpsed a dancing figure, darting back and forth on tiptoe, in and out of the foam, always just escaping the force of the foremost breaker. We caught it with a butterfly net and found it to be a full-grown female, duller than the male, but with a clutch of bright orange eggs held tightly underneath her. She was the only ghost with eggs we had seen on the entire trip, although we had examined dozens of the crabs. Her appearance in the surf, combined with the lack of courtship activities in the crab colony and the scarcity of young during these winter months, suggests that the ghosts of this coast breed chiefly during the rainy season; at that time the increased moisture must help the females to keep the eggs at the requisite degree of dampness during necessary periods of feeding and digging.

We took the lady ghost aboard the *Zaca*, gave her a roomy aquarium with sand banked up at one end and shallow water at the other, and fed her bits of shrimp in lieu of tidal detritus. Within three days all three thousand of her eggs hatched out.

The tenth-of-an-inch youngsters were typical crablets, yet it seemed most unlikely that they could ever turn into proper painted ghosts. Eminently adapted for sea-faring, they were tadpolish creatures, perfectly transparent except for the enormous eyes of black and gold. A large glassy spine pointed forward from their rounded brows and another aft, so that they charged through life like lancers of old.

Just as we upped anchor and sailed away from Honda, I yielded to unscientific sentiment and, except for a mere few hundred saved as a sample, spilled the infants overboard. As they splashed into the bay, I wondered which one or two of all that throng would escape engulfment by a hungry fish or squid or shrimp, pass safely through all the moults prescribed for growing ghosts, and at last, at the proper instant, be cast—not on a harshly rocky shore—but on the friendly, diggable, eatable sand of the Ghost Crab Beach at Honda.

Gray Jay of the North

He Is a Camp Robber, But He Is a Gay and Cheerful Companion When Winter Comes to the Evergreen Forests, Too

Ben East
Nature Editor, Grand Rapids Press

MANY uncomplimentary things have been written and said of the Canada jay. It is the habit of this gray jay of the north to dwell in the vicinity of camps and cabins, and descend upon them frequently for whatever he can find in the way of scraps of food. He has little fear of man and his raids are oftimes surprisingly bold. If a strip of bacon be left unguarded on a log beside the fire he will swoop down upon it and carry it away with not the slightest show of trepidation, though the owner may be busy at the tent door a scant three yards away.

So woodsmen berate the gray jay for his pilfering, and in the north country he is perhaps better known as the camp robber than as the jay. Too, I suspect his reputation suffers by reason of his kinship with the crow and his noisy blue cousin. Corvine birds, the three of them, and because the two are freebooters and rascals the stigma of the clan rests on the gray-clad member as well. There is little of respect in the title of whiskey-jack, by which woodsmen know the gray jay almost as frequently as camp robber. Much of the odium of that name is lost, however, when one knows that it is a white man's corruption of the Cree name for this jay of the evergreen forests, and is not meant to indict him as a tippler.

Of all the names by which he is known, I like best the title of moose bird, for I think of him always as associated with the wilderness where moose roam on shadowed trails, the northern wilderness of rocky ridges and swampy lakes, moss-bearded fir trees and gleaming white birches.

Moose bird, indeed, and if there is anywhere in the wilderness a more companionable and likeable bird, I have not met him.

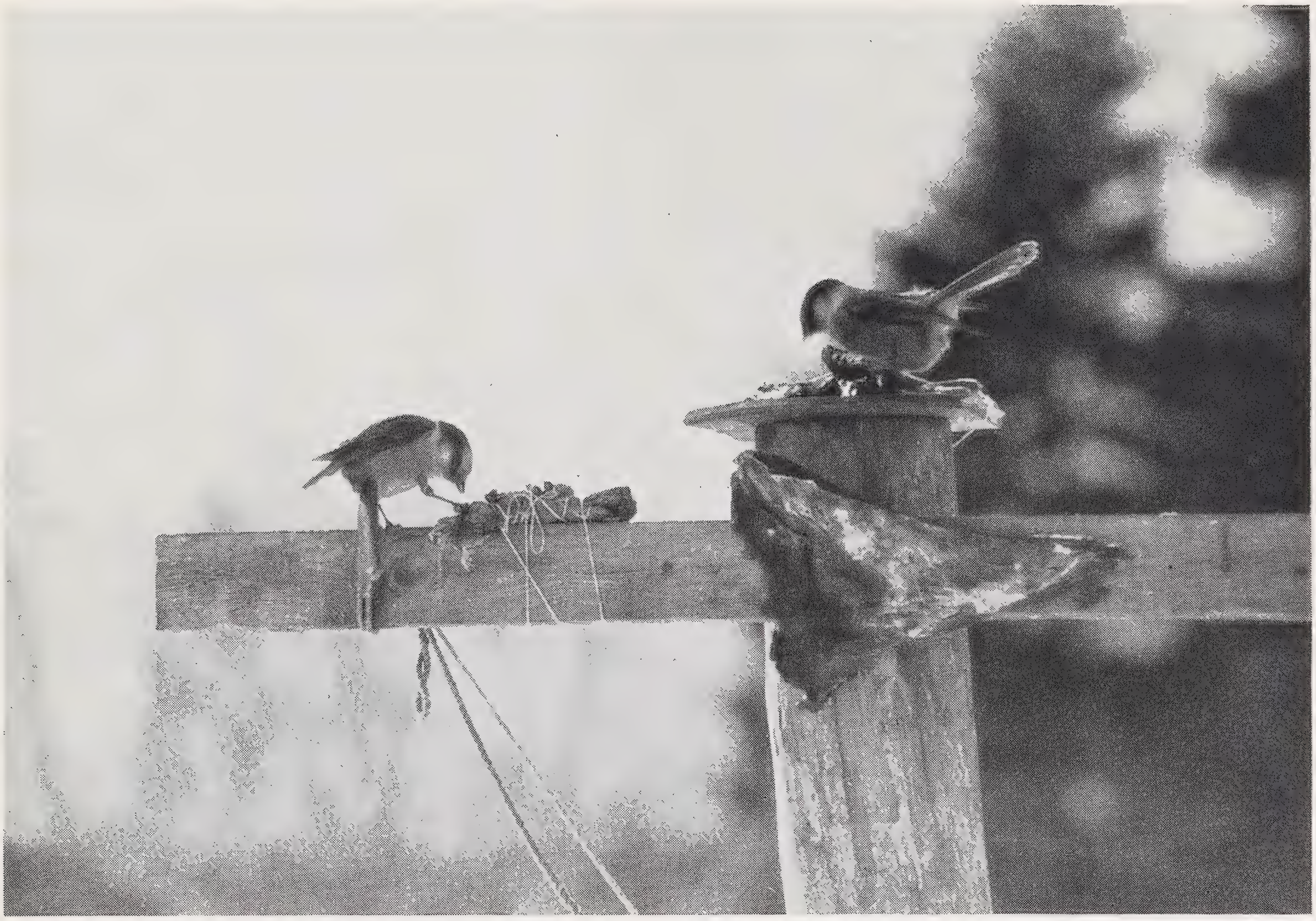
And I speak with some feeling, for three of us lived eleven days one February in a lonely cabin in the northern wilderness with the gray jays as our only neighbors. And if I were to spend an entire winter alone in the brooding silence of the snow-hung north woods, I would not put a price upon the companionship of these cheerful, modest jays.

We had traveled a thousand miles of winter sky roads, in a cabin monoplane, to Isle Royale, long finger of rocky wilderness in upper Lake Superior, Michigan's farthest north and newest of our national parks, to record with our cameras the beauty of snow-crested ridges, of ice-decked cliffs and headlands, of lonely, steep-walled valleys. Three of us, Walter Hastings, a magician in hunting birds and animals with the lens, George Austgen, a pilot of years' experience in winter flying, and myself, to live alone on Isle Royale the better part of a fortnight, to picture the winter beauty of the great island and to learn how the moose, the birds and the other wild folk that are its only winter denizens fared through the long months of cold and storm.

Before we left home a friend suggested to me that we establish a bird feeding station at the fisherman's cabin where we intended to make our headquarters.

Such a station would be almost sure to attract

Photographs by the author.



Suet and fat from the carcass of a moose that had been shot by poachers was tied to the cross-arm of the clothes-line pole, and here the Canada jays came to a rendezvous with the photographers. It had to be tied down so the guests would stay long enough to be photographed.

the gray jays, he pointed out, and the gray jay has not been too often photographed in the winter woods. Too, there would be likelihood we would lure to our feeding tray chickadees, grosbeaks, woodpeckers and other interesting birds of the north. The last advice this friend gave me was that we include a few pounds of suet in our supplies for a feeding station.

But there was a limit to the weight our monoplane could lift, and the things three men must take along for a stay of ten to fourteen days in the wilderness are many. And when we had completed the purchase of our food supplies and weighed them, package by package, they exceeded by thirty-two pounds the maximum weight we had allotted to food.

Either we must sacrifice some item of equipment, cameras, blankets or clothing, or that thirty-two pounds of food must be eliminated to the last ounce for safety's sake. Facing the possibility of short rations in the island wilderness in the event of a disabled plane, we listed our stock of three pounds of suet for the birds among the items that had to be sacrificed.

Lack of suet did not prevent us, however, from establishing a feeding station at our back door the first morning after our landing on Isle Royale. We moved into the cabin of an Isle Royale fisherman, one Holger Johnson, deserted for the winter, and in the fish house we found more than a ton of salt herring stored in kegs. We ate freshened herring for breakfast that first morning, and after the meal we put the fish scraps on the cross arm of a clothes-line post behind the cabin.

Word of our smoke, curling up from the stove pipe at daybreak, must have gone abroad through the forest. The food was no more than out when the first of the jays came swooping from a thick spruce tree a hundred feet from the door, darted down and carried off a generous helping of the scraps.

At no time from then on did we lack guests at our banquet table. Four or five pairs of moose birds made their headquarters in the forest about the Johnson place and they came regularly and often to our feeding station. We tried them with bits of cold pancake and fried potatoes as well as with the fish scraps, and they seemed genuinely grateful for whatever we put out, although the cold pancakes were the least popular of the offerings.

We soon found, however, that food of this kind was not what we needed if we were to make pictures of the gray jays. It was hard to tie fast a strip of cold flapjack or a handful of fish bones and the bold little guests darted down, grabbed a generous helping and were gone before we could get the cameras into action.

Time after time we watched them carry away scraps of food that seemed far too heavy for them, grabbing the prize in their bills and then transferring it to their feet as they left the station to fly to the nearest spruce.

We finally decided they could not possibly eat the quantity they were taking, and we began to suspect them of hoarding it in some secret hiding place. At last we climbed up among the thick branches of the spruce, intending to rob the cache, but our search revealed no store of food. The cold of northern winters begets healthy appetites, and it is the way of the gray jay to feast while the board is spread. The time of like bounty may be weeks or months away.

We felt, however, that our guests were getting the best of the bargain. We were furnishing them a plentiful supply of food and getting no pictures in return. And though their gay companionship was payment enough for what they took, it was pictures we desired, after all.

Fate smiled upon us at last, however, and upon the jays as well. In a swamp far to the east of our camp we came upon the carcass of a moose shot by poachers earlier in the winter, weeks before we came.

We cut off two or three pounds of suet and fat from the frozen carcass and carried it back to camp for our guests. From then on we traded meals for pictures to the complete satisfaction of everyone concerned. We tied the fat down in such a manner that the jays could tear off only small pieces at a time and while they worked at it we were busy with our cameras.

For the first few days we put all the food on top of the clothes-line post. Then Hastings wanted a location with better light and a forest background, so he made a feeding station of a short section of board and a balsam pole from the woodpile.

This was set up in the deep snow within four or five feet of our door and our bird photography became even more easy. We had only to open the kitchen door and make gray jay pictures whenever we chose, without stepping outside the cabin.

Welcome neighbors, friendly, intimate, gay, they appeared at the door even on days when the island was lashed by shrieking winds and dry, hard-driven snow. On such days their visits were brief. They darted down from the nearest spruce tree, clung for a few seconds, taking what bits of food they could before the wind tore them away, whirling back to the shelter of the forest again.

The north has no room for weaklings. Hardship is the lot of those who dwell with her, and the gray jays, like the others, face it uncomplainingly, knowing she will repay them in divers ways when she is in a gentler mood.

Among those that came to our feeding station was a one-legged cripple, the victim of an accident of some sort. Perhaps, questing for a tidbit of fat, he had sprung a wolf trap and the snapping steel jaws had cut the leg cleanly away, leaving only a short feathered stump.

He seemed to suffer little inconvenience, however, and he was as sprightly and gay as any of the band. He came regularly, perching on his one foot and tugging lustily at the moose fat, and never the wind blew too cold for him, never the snow swirled across the harbor in a smother so thick that he did not dart down from the spruce trees and take his share of the food, poised on his one good leg, braced against the searching gale. The north has no place for weaklings, indeed!

Despite their close kinship to the noisy and bold blue jay, the moose birds are quite unlike that blue rowdy in nature. They are quiet, modest and peace-loving. While the blue jay heralds your passage through the forest for all the world to hear, screaming at the top of his voice that an intruder goes here, the gray jay will sit quietly in spruce or fir while you pass by and the chances are you will never know he is there.

He has a call note, soft and pleasing, not greatly unlike the low alarm call of the robin, and to hear the robin-like cry coming from the center of a balsam thicket in the north woods on a bitterly cold and stormy day in midwinter—when you know the nearest robin is hundreds of miles away in a gentler land—is to the uninitiated a puzzling but cheering experience.

We encountered the gray jays in other places on our snowshoe journeys over Isle Royale, but nowhere did we find them as tame and friendly as about our camp. I sat beside the frozen moose carcass at the head of Lake Mason for more than an hour one afternoon and the silent snow-hung woods about me were literally alive with birds. But of them all, only the chickadees were bold enough to feast while I was there.

The gray jays, confident enough back at camp, did not trust me sufficiently here in the forest to approach their feeding place. They stayed back a safe distance in the timber, moving restlessly from tree to tree and carrying on a soft questioning conversation among themselves, as if asking each other how long the uninvited guest would linger at the banquet table.

Somewhat to our surprise, two pairs of blue jays lived about our camp and came frequently to our feeding station, usually shortly after daybreak, their harsh cries waking us morning after morning. They were far more wary than their gray cousins, however, and evaded all our attempts to photograph them. I found another pair or two loitering about the scene of the moose kill, well out of camera range, and they shouted the word of my presence to all the forest as soon as they discovered me.

We met many other interesting birds in the wilderness of the island and some of them visited our feeding station. Chickadees were everywhere in the timber, flocks of crossbills fed on spruce cones in the swamps, woodpeckers were abundant and friendly.

On two occasions we met at close range the pileated woodpecker, the log cock, of black and white plumage and scarlet crest. Nearly as large as a crow, this great woodpecker is one of the showiest birds of all the winter forests.

Then there was Hush-wings, a great horned

The Canada jay in person—the friendly gray bird that is called by the name of "Camp Robber," "Whiskey-Jack" and "Moose Bird" in the northlands. It is a close relative of the bold and noisy blue jay, but of a far quieter and more peaceable disposition.

owl that lived along the trail we took from our ship down to the Johnson cabin. We never saw him but he marked our passing each time with harsh hooting until we came to expect his grim, hollow cries whenever we went that way, at daybreak, midday or dusk.

By an interesting coincidence, it was on Isle Royale, four years after our winter visit, that Hastings and I were to have the experience of photographing the first nest of a Canada jay ever found in Michigan.

Despite the fact that the moose bird is a common resident of the evergreen forests from the limit of trees south to the northern tier of States and over the eastern two-thirds of the continent, his nest can hardly be called a common find.

Nesting records are rare, even in districts where the bird is known to dwell the year around. In Michigan, for example, the Canada jay is fairly common throughout the upper peninsula. Immature birds were taken many years ago, and it has always been assumed that the jays must nest somewhere in our northern wilderness. Yet, up to the time of our Isle Royale find on April 30, 1935, no positive evidence had ever come to light to support this belief, either in the shape of nest, eggs or fledglings.

Even museums find the eggs of the gray jay difficult to obtain. The Cranbrook Institute of Science, at Bloomfield Hills, where our Isle Royale nest finally came to rest, has tried unsuccessfully for years to obtain a set of eggs to fill the empty bowl of twigs and bark.

The reason for this rarity of nesting records of the Canada jay doubtless lies in the bird's habit of beginning his housekeeping affairs very early, in March or April, long before the normal nesting season in the dark forests of the north. Few woodsmen are looking for bird nests while the last of the winter snows still lies deep in the swamps, few professional ornithologists are afield at that season, when the bitter nights still record temperatures down to 30 degrees below. It is typical of the gray jay, child of the deep north that he is, that he pays no heed to storms and cold when the climbing sun of March stirs the spring ardor in his blood, when the nesting impulse is on him.

We were on Isle Royale that spring in connection with the transfer to the Michigan mainland of a little band of moose live-trapped there during the winter. Starvation had thinned the ranks of the great island herd the previous year, and Michigan was launching its attempt to establish a moose herd in the Upper Peninsula with a small herd of trapped animals, and at the same time save a fragment of the island population from slow death by hunger. The project was in its initial stages that spring, with eleven moose in the island corral awaiting the long boat journey across Lake Superior.

The story of the trapping and moving of the moose was told in this *Bulletin* in the summer of 1936.

The rest of the party was busy about the moose corrals the day I made the find of the Canada jay nest. I had twisted my ankle badly two days before, and was just getting back on my feet after an enforced rest of thirty-six hours.

I took my cameras and limped inland a half mile or so from the Chippewa Harbor headquarters of the moose party, to a cutting where birch and other trees had been felled for moose food during the winter.

The ankle was still giving me trouble, and I picked an open sunny spot on the side of a ridge and sat down to smoke and rest my foot. I had been quiet no more than two or three minutes when a Canada jay alighted on the ground within two or three yards of me and began scratching in the dead leaves and other ground cover for food.

Something in the attitude of the bird hinted instantly that she was feeding young in a nearby nest. It seemed unlikely that I was going to be lucky enough to stumble onto something for which veteran bird men had searched vainly so many years, but I held my breath and waited, my eyes glued on the busy whiskey-jack.

I hadn't long to wait. She worked on the ground a minute or two, paying no attention to me, then flitted swiftly off down the side of the ridge and alighted in a spruce at the edge of a narrow tongue of swamp. A brief pause there and she took wing again, flying a hundred feet or so along the shoulder of the ridge to a small balsam. When she stayed in the balsam top I marked both trees carefully, set my camera down so that I could return to the exact spot and started to follow the bird.

I was half way to the balsam when two jays flitted out and I could see the bulky nest looming plainly among the branches.

In all my years of hunting wildlife with a camera I can remember few times more thrilling than that.

The nest tree had been browsed heavily by moose during the winter. They had stripped the branches as high as they could reach, eight to ten feet above the ground, and the jay nest was perched on the lowest of the unbrowsed branches.

It was a bulky, high walled structure, showing considerable fluffy cotton-like stuff interwoven with twigs, strips of bark and other construction material. That cotton puzzled me. I was unable to identify it as any plant fiber native to Isle Royale. It was not until three months later, when I returned to the place to collect the abandoned nest, that I finally solved the puzzle.

The balsam was too small to climb. To gain a glimpse of the interior of the nest I started up a small birch that grew three or four feet away. I had barely left the ground when a young jay came scrambling over the edge of the nest and fluttered down on untried fledgling wings.

Over the rim of the nest I could see three or four more heads peering apprehensively at me. I had no wish to drive the entire family out of their home prematurely. I stayed quiet for a few seconds until the excitement subsided, then slid silently down the birch trunk.

The young jay was not quite old enough for full flight, but he was well feathered and he had made his initial landing without injuring himself.

The instant I touched the ground I was the object of a spirited attack by two angry, distraught gray jays. They came swarming at me like a pair of enraged overgrown bees, swearing at the top of their voices. Somewhere I had read that a Canada jay can cuss as fluently as his gaudy blue cousin. Up to that time I had always doubted the statement, but the jay language I heard there beside the nest tree dissolved my doubts.

The birds did not actually strike me but they flew back and forth over me, fluttering less than a foot from my head and swooping at me repeatedly from behind as if hopeful of routing me by an attack from the rear. Time after time one or the other left me briefly to perch beside their fledgling, where he huddled disconsolately on the ground, fussing, scolding, then suddenly darting back into my face in anger and resentment.

The birds stayed too close to me, and the action was too fast, to permit the use of my camera. This was a job that would call for two photographers. Anyway, I couldn't leave Hastings out of a party as interesting and important as this one. He was back at the moose corrals, and I knew he'd give his right eye for a chance to work on this jay family with his big motion picture camera.

The young bird started moving off, fluttering along on the ground. It was obvious he wouldn't be available as a model if I left him for long. Finally I solved the problem by imprisoning him under my hat, weighting the brim down with two small stones. Then I hobbled back to the harbor for Hastings, leaving the parent birds trying vainly to free the youngster.

Jack Van Coevering, a third camera hunter, was at the corrals with Walt. We gathered up the camera equipment and started back.

The pair of jays met us some two or three hundred yards from the spot, but they had changed their attitude completely. They no longer showed any anger. Instead they had fallen silent and crafty. They flitted off ahead of us for a short distance, made no attempt to follow when we continued on toward the nest. They gave no outcries, and long before we reached the nest tree they had disappeared in the forest.

The fledgling had settled down under the hat, warm, quiet and contented. We removed the hat, arranged our cameras and waited. Within a few minutes one of the parents, we assumed the female, returned quietly to the nest, bringing food for the family. She seemed to have forgotten all about the lost youngster. She finished the job of feeding, flew off, and while she was gone we moved the stray out into the open where he would be sure to attract attention. The ruse worked. The mother saw him on her next return and came storming down at us once more. Her mate heard the fuss and sailed in to join her, and the two of them staged a second attack, angry but not quite as spirited as the first. When we refused to be driven away they gave up, abandoned the luckless fledgling to his fate and went back to the task of feeding the young birds still in the nest.

Time and again the mother came to the branch of the nest tree where the lost youngster was perched, and fed him. The click and whirr of the cameras did not disturb them, and after the pictures were taken the baby was lifted up to the rim of the nest he had rashly abandoned.

By the time we finished with our pictures of the baby jay he had grown tame and contented, perching on our fingers or our heads with no evidence of either fear or resentment. He seemed in a fair way, in fact, to adopt us in the place of the parents who had deserted him.

We perched him finally on a low branch of the nest tree, three or four feet above the ground, took up our vigil a couple of yards away with our cameras focused and ready, and waited for the parent birds to return.

One was making feeding trips at regular intervals of five to ten minutes. She came in on the next trip, alighted in a birch a short distance away and was attracted by the peeping of the lone youngster. She went to him at once, ignoring the others in the nest above.

Time and again she came back and fed him, perching close beside him for a few brief seconds while he begged with gaping bill, then suddenly thrusting her bill within his and giving up the morsel she had brought for him. The sharp clatter of our camera shutters and the steady whirring of Hastings' motion outfit a few feet away failed to disturb her in the slightest degree.

When we finished our pictures the fate of the young jay and the rest of the family remained to be settled. Plenty of scientific institutions, we knew, would be glad enough for a group as rare as this. But somehow none of us had much heart for the job of collecting, after the hour or two we had spent there with the gray jays.

For a minute the problem of how to reunite the family puzzled us, but that was easily solved. We found a dead stick large enough for the job, stood it upright, perched the stray fledgling on the end of it and poked him slowly and carefully up through the branches to the nest. And was he glad to get home!

When his improvised elevator came level with the rim of the nest he took one look at the warm shelter he had deserted so casually earlier in the afternoon, hopped hastily over the edge and settled down among the other fledglings like any grateful prodigal.

Three months later, at the end of July, I went back to get the discarded nest for Cranbrook. It was then that I learned the identity of the cotton-like material that had gone into its building.

The walls of a log cabin at the Holger Johnson place, a half mile away across the ridges, were generously chinked with kapok from old discarded life preservers. The Canada jays, in typical corvine fashion, had made trip after trip to the cabin while their nest building went on, raiding the chinking for wisps of kapok that served their purpose perfectly. That kapok probably had grown on the island of Java, many thousands of miles away from the northern wilderness where it finally found its way into the home of a pair of ingenious, tireless, brazen whiskey-jacks. It is my belief that they had the only kapok-lined nest ever built by gray jays in the whole history of the clan.

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All pictures not otherwise credited are from the photographic collection of the New York Zoological Park and the Aquarium.

Notes from the Zoological Park, Aquarium & Department of Tropical Research

Lectures for Members

Dr. William Beebe will open the Society's 1939 lecture series for Members on Tuesday evening, February 14. His talk on "Creatures of Jungle, Sea and Air" will be illustrated by motion pictures taken on the expeditions of the Department of Tropical Research to British Guiana, Bermuda, the Galápagos, the eastern Pacific and elsewhere.

Dr. Raymond L. Ditmars will be the second speaker, on Thursday evening, March 23. Out of his long experience as Curator of Mammals and Reptiles he has chosen examples of "Strange Animals I Have Known," illustrated by motion pictures.

The lectures will conclude with a talk by Fairfield Osborn, Secretary of the Society, on Thursday evening, April 20, on "Five Mysteries."

All the lectures will be held in the auditorium of the Engineering Societies Building at 29 West 39th street, at 8:30 P.M.

Fish escape so rarely from the Aquarium that when they do it is likely to be real news. One of the strangest escapes occurred during the past month when an eight-pound weakfish leaped through two layers of glass, each an eighth of an inch thick, and landed on the floor seven feet below the bottom of its tank. Several visitors happened to be watching the tank at the moment and they called an attendant who put the fish back in water. Its head was slightly damaged by the glass and the fall to the floor, but it appeared unharmed otherwise and swam away unconcernedly when it was returned to the tank.

Dr. William Beebe was recently made a member of the National Institute of Arts and Letters.

Rescue Story

The Bird Department now has another answer to the perennial question, "Where do your animals come from?" Sometimes they come from the New York Botanical Garden.

A man recently phoned Curator Crandall that there was a bird high in a tree in the Botanical Garden, with a trap on its leg. The Zoological Park's forestry department dispatched William Huber, its best tree climber, to investigate and half an hour later he returned with a young red-tailed hawk. Huber found the bird on a limb almost fifty feet above ground. It had stepped into the jaws of a small muskrat trap which apparently had been fastened to some object by a piece of wire. The hawk had pulled the wire loose and had flown off with the trap still on its leg. Somehow it managed to get the dangling wire wrapped around a limb of its tree perch, and it was securely caught.

Except for a sore leg, the bird was undamaged and after a few days in the Hospital it was in perfect condition. The collection happened to lack a red-tailed hawk and the young bird was just what Curator Crandall wanted.

Baby Dragons

St. George and all the other dragon-slayers seldom bothered with the nestlings the monsters must have left behind. At any rate, they failed to give us any scientific descriptions. Nobody knows if Perseus' dragon cut its first scales at the age of two months, or started fire-breathing before or after engulfing its first maiden.

In this respect we are far ahead of the ancient heroes in our study of the deep-sea dragons—those jet-black fish with port-hole-like rows of luminous spots, flashing cheek-lights, sabre-fangs and glowing chin tentacles, which feed on fishes as large as themselves. For on the Bermuda Oceanographic Expeditions we have taken several dozen young dragonfish in the same nets with their adult relatives, and, by means of some careful detective work, have been able in most cases to refer the youngsters to their proper species, although we have caught thirty-five different kinds of these melanostomiatids.

The baby dragons look as little as possible like their ferocious parents, being fragile, milk-white bits of protoplasm minus fangs, lights, chin tentacles and even stomachs. Their only apparent assets are large eyes, generous jaws and extra-long intestines, in place of stomachs, for digesting the tiny crustaceans on which they feed.

Our detective work, in identifying them, consists largely in counting their body segments and rudimentary finrays under the microscope, as well as in noting the pattern of the scanty larval pigment spots. These spots, fortunately for us, disappear only after some of the characters typical of the adult have been developed.

The young fish acquire jet black skins and light organs long before their teeth are fully grown, skeletons firmly ossified, or even fins and stomach completely formed. In fact, it seems that the principal object of dragonfish larvae is to win through to the safety and efficiency of an adult external appearance as soon as possible—so that juvenile dragons swim about all dressed up like mother.—J. C.

"For a complete knowledge of our western history, this book is indispensable."

—PAUL ENGLE, *Cedar Rapids Gazette*

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● Reviewers have extended a uniformly cordial welcome to this history of the American Bison written by a member of the New York Zoological Society's staff, and published by the Zoological Society. It is magnificently illustrated by 65 halftones and linecuts.

"[Mr. Garretson's] book will have to be included in every man's library, or the library will be incomplete."—E. CARL SINK, *Winston-Salem Journal and Sentinel.*

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PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Forty-one volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XXIII are complete and indexed. Volume XXIV will be issued during 1939, in quarterly parts. *Zoologica* is sent to members on request.

[*Zoopathologica,* Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica. Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report, Zoologica* and *Zoopathologica,* as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to Publication Office, Zoological Park, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

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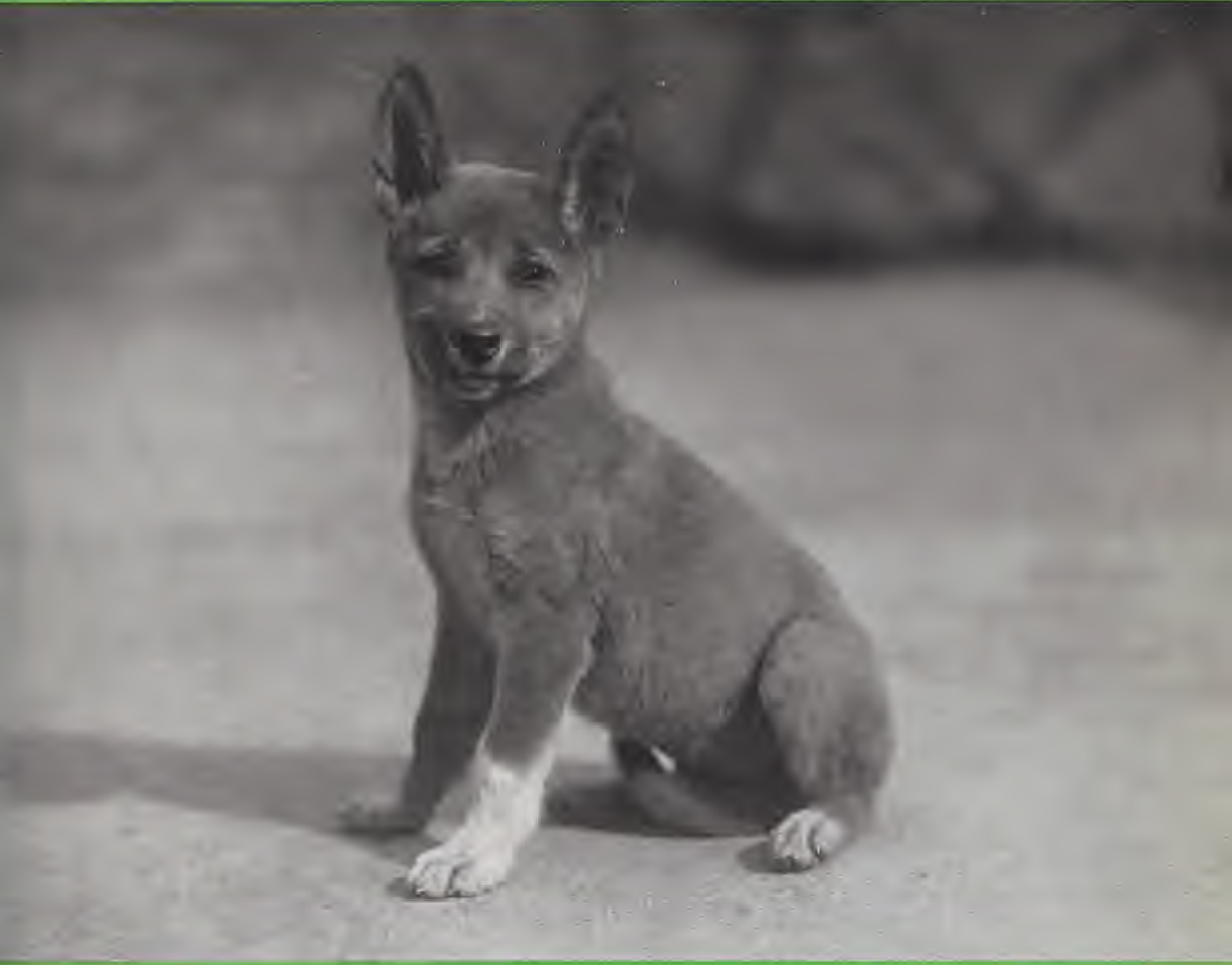
NEW YORK ZOOLOGICAL SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

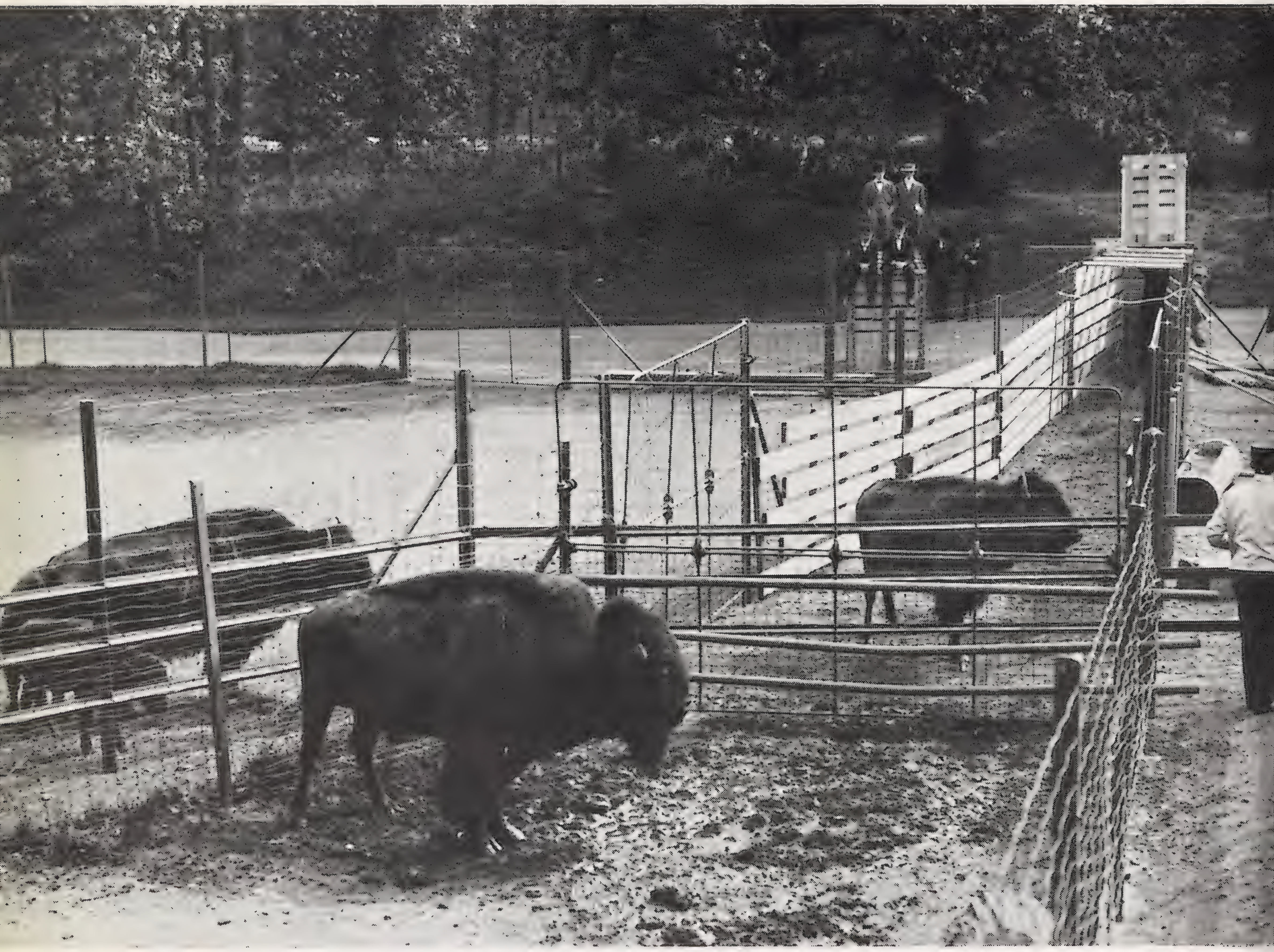
Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



CRATING BUFFALO ON A HISTORIC OCCASION

In October, 1907, the Zoological Society undertook what might have been a big and difficult job—crating fifteen head of buffalo for shipment to the Wichita Game Preserve. Slowly and without excitement, the finest animals were cut out of the Society's herd, worked into a runway leading to a crate at the far end, and as each animal entered its crate, the door was dropped. M. S. Garretson, who was standing on top of the Bison House watching the scene when this picture was taken, remembers that the whole job took only part of one morning and that only one buffalo had to be forced to enter the crate.

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Handling the Animals

Every Trade Has Its Tricks, and the Business of Taking Care of a Zoological Collection Needs Plenty of Them

WILLIAM BRIDGES

IT was one of those mild, bright days that forecast spring even in midwinter, and the window in the end of the Hospital hall was wide open to the warm breeze. Dr. Schroeder, carrying a tray of microscope slides, popped out of the Laboratory — and ducked the whirring wings of a Blue-and-yellow Macaw. He grabbed. The bird went out of the window.

* * *

"Mr. Crandall? This is the Hospital. Your Blue-and-yellow Macaw's out—twisted the wire off his cage door and went out the window."

"All right; keep an eye on him. I'll send George Scott over."

* * *

The Macaw circled the Hospital, a spectacular fragment of the tropics among the January branches of the trees, and came to rest on the broad arm of an oak in the swale beside the Hospital. It was a comfortable perch, full in the warm sunshine, and it was visible from his quarantine cage in the Hospital. Would it be far-fetched to suppose that he might have eyed that perch and chosen it in advance? At any rate, once he attained it, he turned his back into the sunshine, rested his head on his shoulder, and went to sleep.

He was still dozing in the almost-tropic warmth when Keeper George Scott arrived twenty minutes later, now and then unfurling himself enough to cock a careless eye at the ground thirty feet below. He paid no attention to the apparatus that was brought to the tree with all the noisy bumping and confusion of men who are trying to get a twenty-foot ladder through a thicket without making a noise. He dozed on while the ladder was set against the trunk of the tree and one of the Hospital attendants tried to shinny up the remaining ten feet of rough bark. He scarcely shifted a foot when a rope went whizzing toward a higher branch on the opposite side, missed, and fell thumping to the ground.

When it became obvious that there was no way of getting up into the tree to bag the Macaw in a net, Keeper Scott prepared a limestick. The technique of making birdlime, coating the sticks and catching birds with them is virtually a lost art and few bird men nowadays know how to do it. Curator Crandall learned the process long ago and for years the Bird Department has kept a small bundle of limesticks on hand for just such emergencies as this.

Since the Macaw was a large and powerful bird, Keeper Scott slipped two sticks into the notched end of a long bamboo pole and when he had climbed to the top of the ladder the pole was passed up to him. Wendell Phillips declared that "Eternal vigilance is the price of liberty," but the Blue-and-yellow Macaw had never heard of the Boston orator. He slept on, unconscious that the tip of the pole and its sticky crosspiece was hovering over his back. He never dreamed that his holiday was at an end until the lime-

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A tame Sulphur-crested Cockatoo poses to show how he might allow himself to be captured in a net — just supposing he were rash enough to try to fly away.

One swoop of the net, and the bird is captured. A soft netting is used, and there is no danger of injury, no matter how "Cocky" tries to flutter about.

The bird thoroughly entrapped, the keeper can now seize it from outside the net and then reach inside and remove it. In this way most small birds are caught up.

sticks touched the crossed ends of his wing-feathers and clamped them together. Then he made one indignant, startled leap—and dropped straight down and into the arms of a Hospital attendant. Within ten minutes the lime had been washed off his feathers with kerosene and he was back in his quarantine cage and its door was clipped by a tiny padlock.

* * *

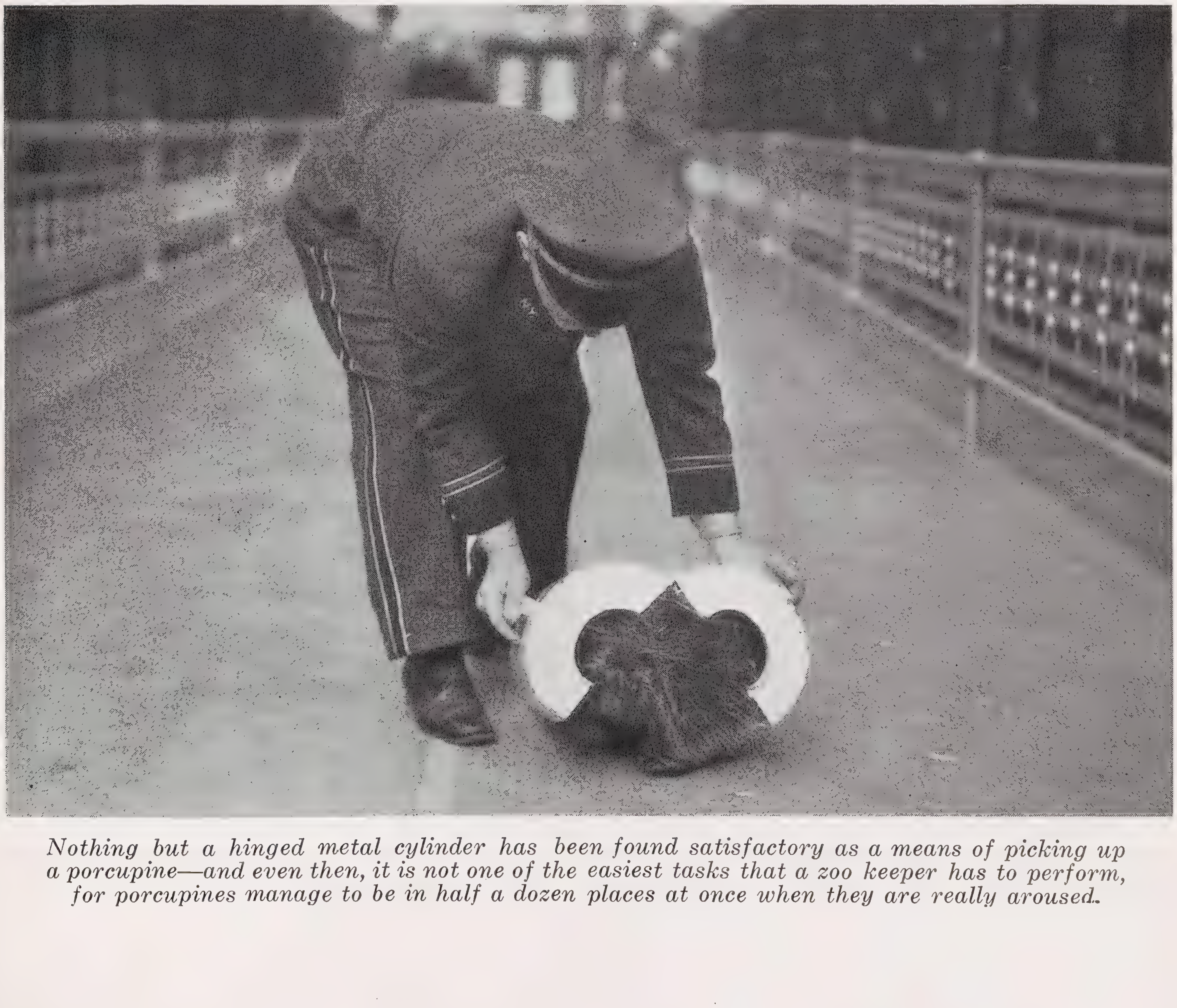
Every trade has its tricks, and the keepers of a wild animal collection must be master of many. They must know how to pick up a rattlesnake or a porcupine, catch one particular bird in a cage that may contain fifty, immobilize a tiger that needs to be examined or transported. They must possess the kind of "horse sense" that will enable them to anticipate the actions and reactions of the slyest and most cunning wild beasts. Above all, they must have the skill and the ingenuity to handle their stock with safety both to themselves and the animals, for there is no use, for instance, in catching up a recalcitrant giraffe if in the process it breaks a leg.

Birds are in some ways the easiest, and in others the most difficult, of all the creatures in the Zoological Park to handle. With the exception of some of the large flightless birds of uncertain temper and the heavily clawed and strongly beaked birds of prey, most of them can be handled without elaborate precautions for the safety of the keeper. On the other hand, while mammals and reptiles that may get loose in the course of manipulation generally remain in realms where humans can pursue them, a bird on the loose is quite likely to head for the topmost branch of the tallest tree or soar off toward the far horizon.

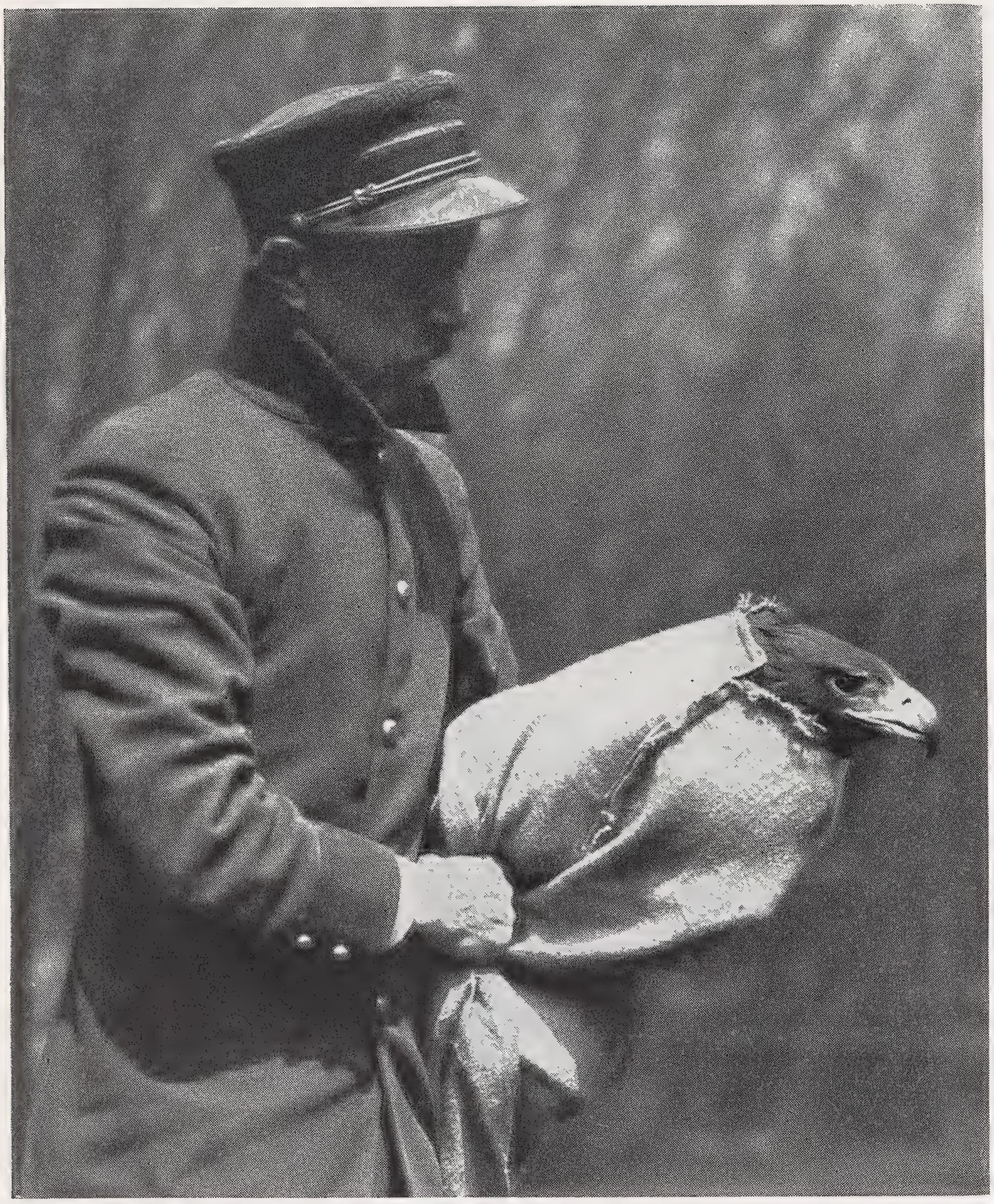
When that happens . . . It is unfortunate to have to report here the words of Curator Crandall:

"When a bird gets away, we wonder, just like anybody else, what we're going to do. All we *can* do is go after it and hope for a break."

Actually, of course, the Bird Department's plight isn't quite as helpless as those words sound, for its men do have a good working



Nothing but a hinged metal cylinder has been found satisfactory as a means of picking up a porcupine—and even then, it is not one of the easiest tasks that a zoo keeper has to perform, for porcupines manage to be in half a dozen places at once when they are really aroused.



An eagle is a difficult and sometimes dangerous bird to handle because of its fierce beak and sharp claws. When they have to be taken to the Hospital, as sometimes happens, they usually are captured in a net and then encased in a stiff bag with only the head projecting.

knowledge of bird psychology and the nets, limesticks, bags and so on that can be applied when the "break" comes.

"Years ago," the Curator of Birds went on, "a hornbill got away from us in the Ostrich House. It was a piece of pure carelessness; somebody didn't latch a gate, and the bird slipped out. The first thing I knew about it was when an excited little boy came bursting into the office with the news that a bird with a big beak was flying around the east side of the Park.

"Well, we soon found out what it was, and three or four of the men started after it. They had long-handled nets and short-handled nets, limesticks, poles and ladders, and it was pretty hard going through the woods, but the hornbill was having a wonderful time. It happened to be a mild spell in early winter and the bird didn't feel the cold too much—just enough to make him lively. He'd fly into a low tree and just about the time they were creeping up on him, he'd take off for the next tree.

"That kind of a chase kept up all afternoon until dark, and all the next day until dark. By that time the men had climbed pretty nearly every sizeable tree in Bronx Park East and they were getting discouraged. I was all ready to mark the bird off our list, too.

"But the next morning, when they came to work, there was the hornbill—in the cellar areaway outside the Ostrich House. He'd come back during the night and pitched down there to get protection against the wind, I suppose. Of course, the men waded right in and threw a net over him in no time. And the bird wasn't any worse off for the experience—went ahead fine after that."

That was one case when all the ingenuity in the Bird Department stood the men to no avail. There just wasn't any "break" that they could take advantage of.

"But there was another time," said the Curator, "when a barbet got loose on us. It was gone for almost a week before we found it in the south end of the Park. We chased it all day long, hoping to get close enough to put a limestick on it, but it wasn't any use. Finally it perched in the top of a little pine tree, about twenty feet above the ground.

"There were two of us working together when the bird alighted—one of the keepers and myself. The bird was watching us, so we separated.

"The keeper stayed where he was and started 'squeaking' to keep the barbet's attention on him. I crept around behind the tree, lifted the limestick—and we had our barbet."

In catching birds that have escaped, hoop nets that can be fitted to long or short handles as the occasion requires are frequently as useful as limesticks. Birds rarely escape, however, and the nets are most often employed in catching up small birds for transfer from one cage to another.

"Suppose there are twenty or thirty small birds in one of the cages and you want to get hold of one certain bird that's been fighting the others or has gone off his feed," said Mr. Crandall. "The keeper opens the cage door and crawls in—the doors are all down at the bottom, you see, and the birds are alarmed and fly up to the top of the cage, so it's quite easy for a man to get in without any of the birds flying out. He takes a light net on a very short handle. By this time all the birds are excited and flying all over the place—the one he wants among them. But it wouldn't do to make wild sweeps with the net—he'd be sure to knock down and kill or injure as many birds as he caught.

"The keeper moves slowly, to keep down the excitement, and he watches the bird he wants. Pretty soon he finds that he's flying a fairly steady course—from a perch on one side to a perch on the opposite side of the cage. Then, when the bird takes off on his return trip, the keeper makes one quick, easy swoop with his net directly in the bird's path, flips the rim of the net when the bird strikes, so as to close the opening, and the trick's done. All he has to do is to grasp the bird from the outside of the net, to keep him from fluttering and possibly hurting himself, and then he can reach down in the net and take the bird out."

With extremely small and delicate birds, the net must be so light as to be almost weightless, and the keeper simply turns the net to close the opening and then upends it over the door of a small cage and dumps the bird in, if it is to be boxed for transportation. Some birds are so delicate that many of their feathers would be pulled out if they were handled at all while in the net.

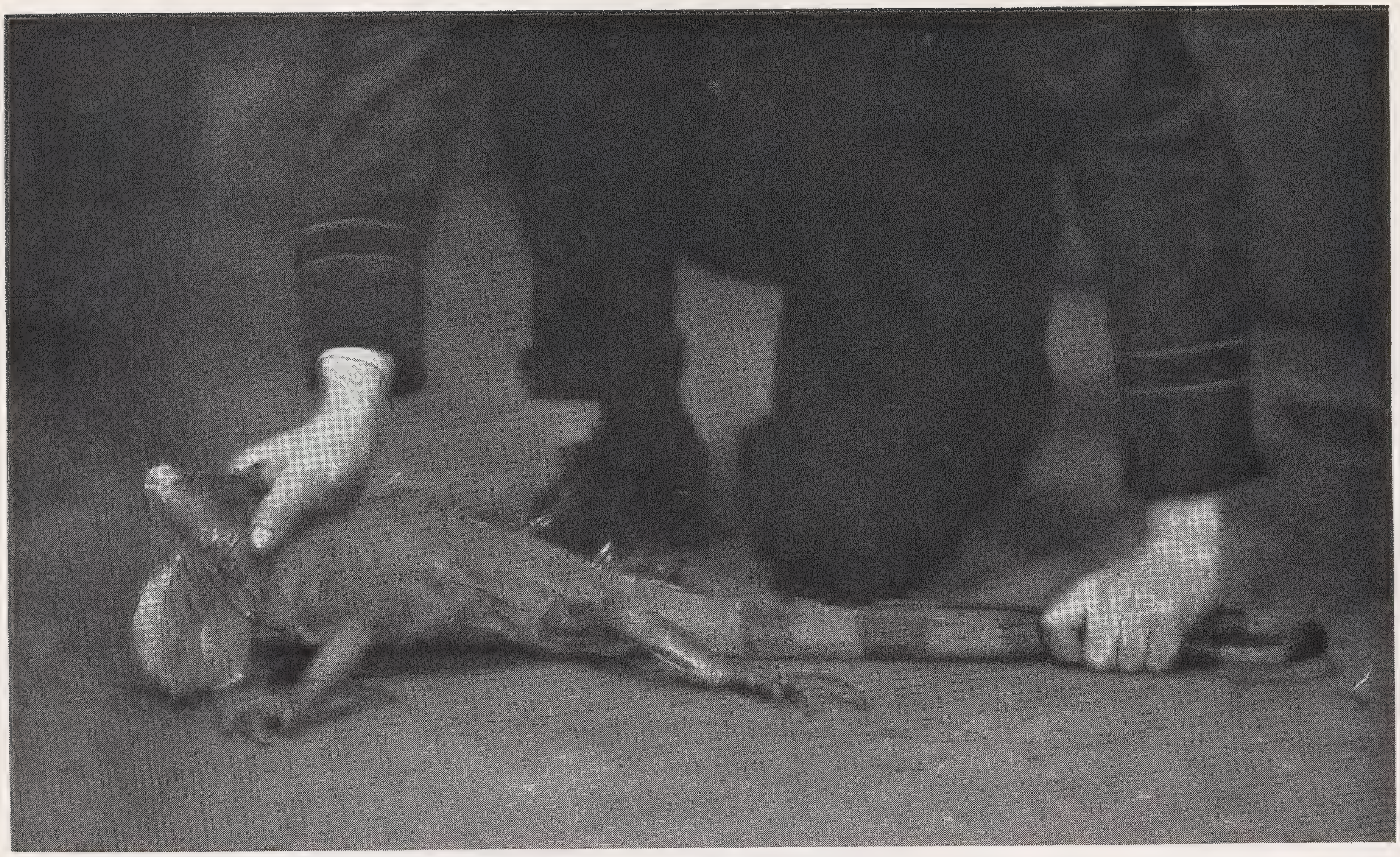
The beautiful Crowned Pigeons are examples. Large and strong-looking as they are, their skin is delicate and their feathers are loosely attached. They can't be netted at all. Instead, they are forced into a corner and then a light bag is popped over them and folded under them. In that way they can be caught and transferred from one cage to another without the loss of a feather, as the Bird House men demonstrated several times this past winter while a new roof was being put on the Bird House and the collection was constantly being shifted.

A good bird man can, with safety to the birds, snatch them off of a perch with his bare hands. Headkeeper Stacey is an adept at that art, but nobody else tries it because there is too much chance of misjudging the amount of "squeeze" required to hold the bird, and injuring it.

Boxing birds is another field of the bird man's profession in which experience, rather than skill, is valuable. With many birds there is a definite limit to the amount of crowding that can be done with safety. To human eyes and senses, a box may be plenty big enough to hold, say, twenty bluebirds. There is plenty of perching space, so that each bird could have a free space between him and his neighbor. But bluebirds have their own ideas of space, and if the box doesn't come up to their expectations they will crowd together in one corner, one on top of another, and some are sure to be smothered to death.

So, too, do partridges, quails, pigeons, doves and pheasants have their special problems. They are apt to "bounce" when boxed for shipment or transfer, and bump their heads against the top of the box. Consequently, the top must be well padded with burlap.

The rule on handling the big flightless birds such as ostriches, emus and cassowaries, is—handle them as little as possible, and never un-



There is a right way and a wrong way to grasp and hold an iguana. This is the right way, and almost any other way is the wrong one—liable to result in the keeper being bitten, scratched by the reptile's claws, or struck by its long and whip-like tail as it thrashes about.

less there are at least two keepers present. It is a dangerous business.

"It's lucky that we don't often have occasion to transfer or handle any of the big birds," Curator Crandall said. "There's a way of doing it safely, but you're always taking a chance of getting kicked in the stomach with those big, heavily-toed feet that could rip you right open."

Ostriches can only kick forward, and that's the clew to the way they are handled.

"Now and then we have to catch up an ostrich. The trick is to get the bird into a corner where you've set up an open crate. Two or three men go into the paddock with shields of light boards and start advancing on the bird. If he gives ground and goes toward the corner, well and good, but if he starts coming at you—well, you turn and run for the gate as fast as you can go!

"Sooner or later, though, you get the bird in a corner and then one man leaps at him from *behind* and grabs his wings. That holds him steady for a moment while another keeper slips a small bag or a sock over his head. Then you can lead him into the crate—rather, you can steer him into the crate from behind—as easily as you please.

"Cassowaries, rheas and emus you get into a crate by some such method too, but mostly you do it any way you can. It's a rather rough and tumble business—with the keepers on the rough and tumble end. There's really no place where you can seize the birds. They haven't any wings to speak of, and they're so strong that if you tried to hold them by the wings, they'd pull off the bird's body. So in those cases, the keepers push the birds as close to the crates as they can and then grab them around the body and try to hang on and push them the rest of the way. It's a great relief to everybody when the bird simply walks into the crate and all but shuts the door behind him, as an emu did last week when he had to catch him up."

Nets are generally employed to catch up the big birds of prey, although they have their drawbacks. An eagle that has been netted instantly declares war on the net and digs his talons into it. Before he can be extracted, every single toe has to be untangled individu-

The same technique employed in seizing and holding an iguana applies to small alligators. Their teeth present even more of a menace to one's hands, but if they are held immediately behind the head and the tail is immobilized, they can be picked up and carried with safety.

ally and held free while the net is worked off the remainder.

"After you've done that a few times, you aren't likely to forget how many toes an eagle has," the Curator of Birds remarked.[1]

* * *

Staccato blasts of the Zoological Park's whistle warn all keepers when a dangerous animal is loose, but the alarm seldom has been sounded in recent years. Probably there never was nor ever will be a zoo from which animals do not occasionally escape—human fallibility, the tendency of iron bars to rust and break, and animal ingenuity being what they are. But in a well-run zoo, escapes are kept to a bare minimum and dangerous situations rarely arise.

The Antelope House was the scene of our most recent excitement. One of the prize possessions of that house was a pair of rooi rheboks, medium-sized antelopes of a nervous and flighty disposition. (A mere pair no longer; during the past month a baby rooi rhebok was born—of which more later.) It was Keeper George Kress's habit to enter the stall several times each day for feeding and cleaning, and each time he carefully pulled the barred gate shut behind him. It is provided with a drop-latch so placed that it is within easy reach of the keeper's hand when he is inside the enclosure, but cannot be operated by the long horns of any antelope inmate.

On one particular day, the keeper entered the stall, closed the door, and began to clean the floor. The rheboks circled him as usual, keeping well away from him, and all seemed normal. The male, however, conceived a sudden fright when he reached the front of the cage, bounced against the gateway—and it sprang open. Examination later showed that the latch was worn and did not drop tightly into place.

Before the keeper could reach the door, the rhebok had bounded out of the stall, over the guardrail into the public area—fortunately empty—and shot out of the open door at the end of the building.

By the time a posse was organized among keepers and foresters, the animal had vanished into the woods, presumably hiding in the thickets at the east side of the Park. Shy and wary

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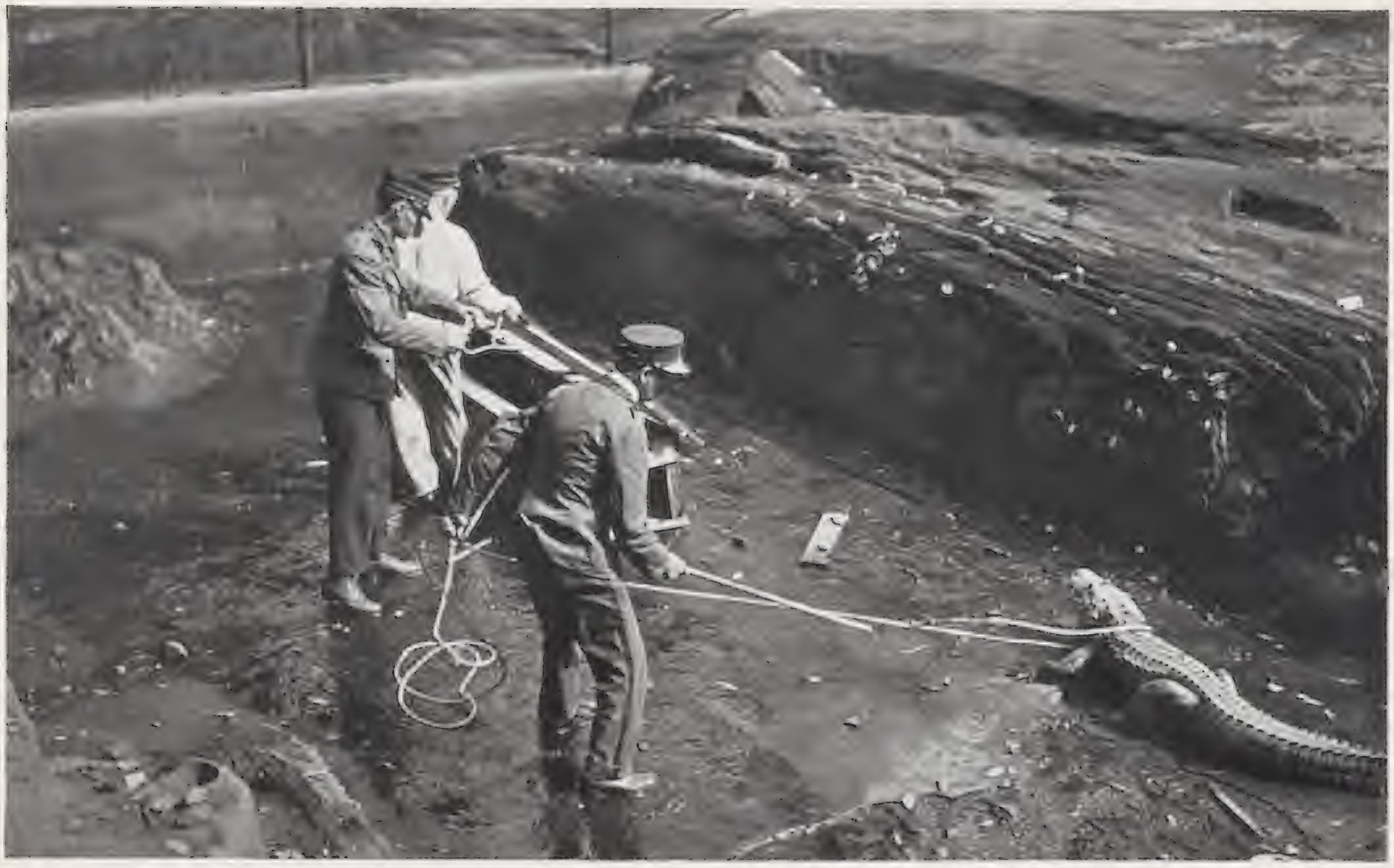
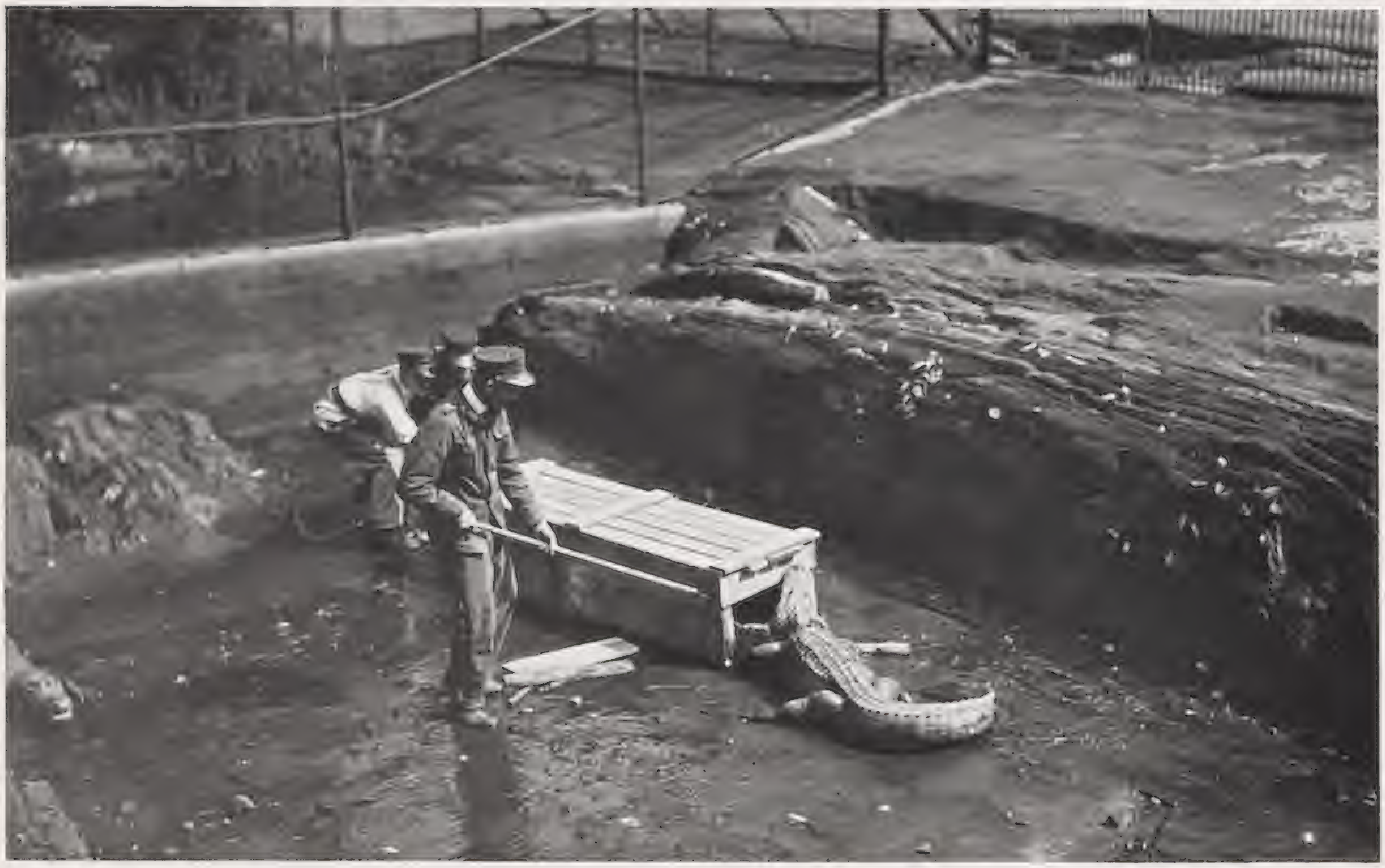
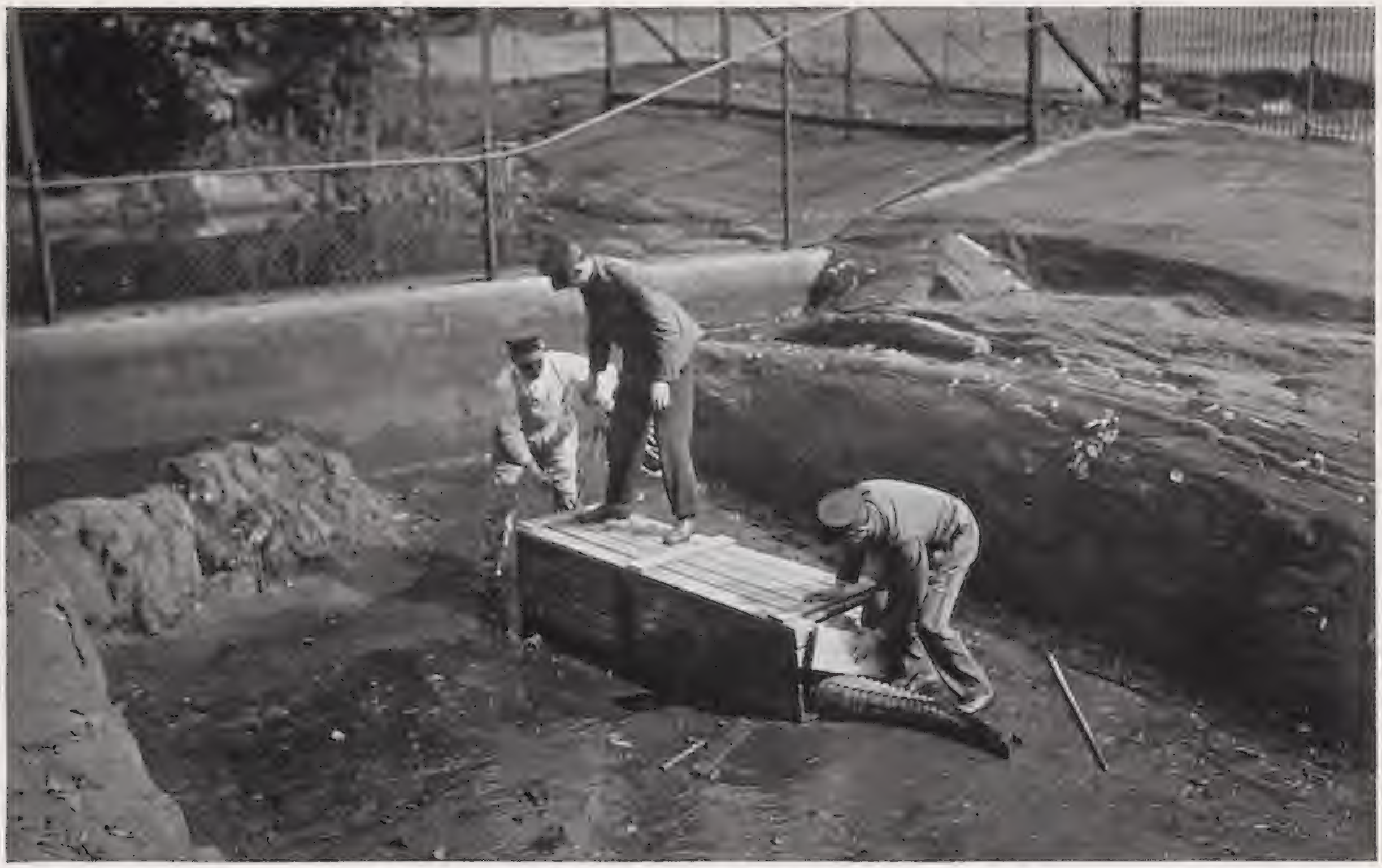
[1] P. S. . . . . Four on each foot.



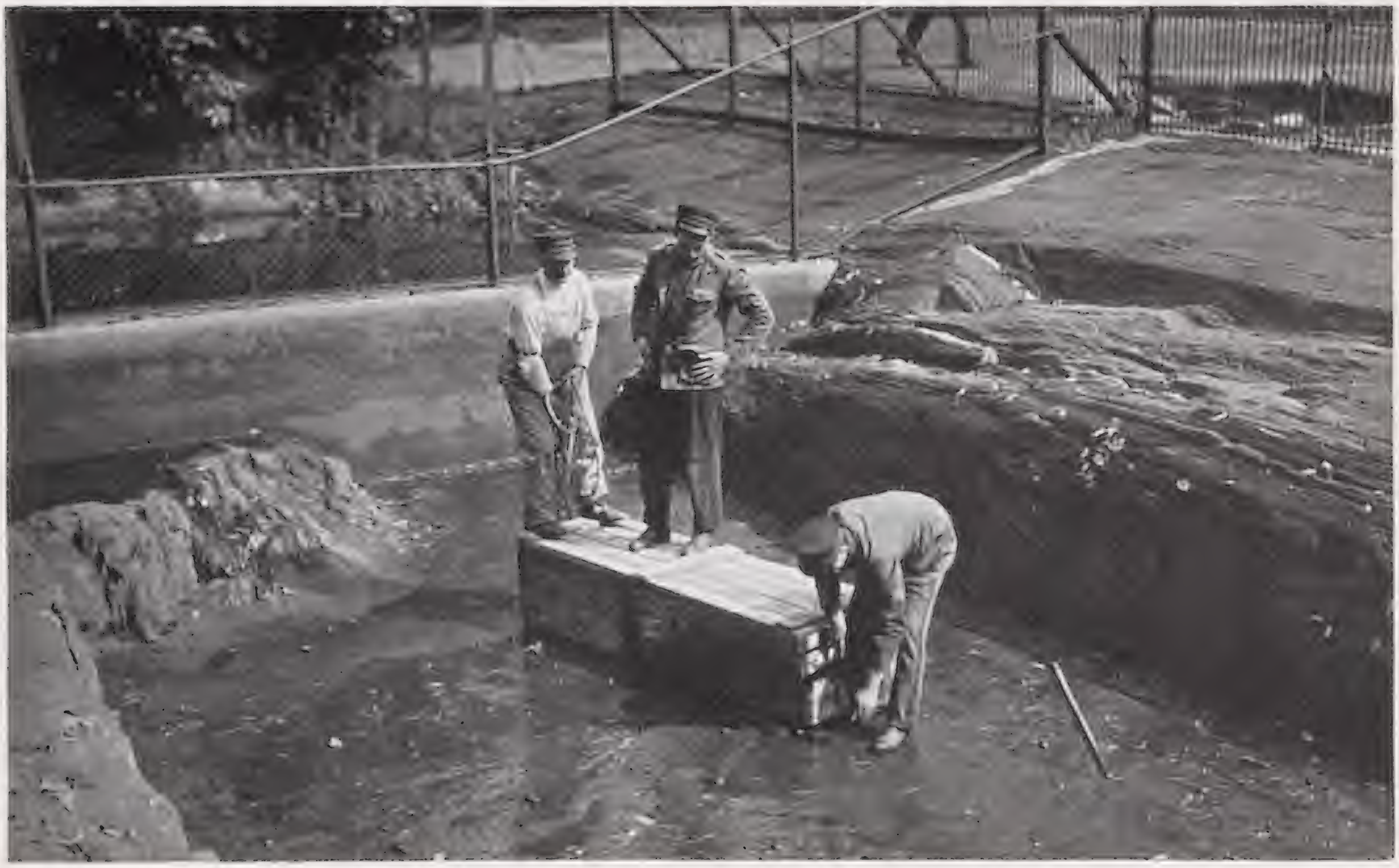
1. First catch your alligator, cowboy style.



2. Then pass the rope through the crate—and pull hard.



3. Problem: What to do with the last yard of alligator?



4. It goes in, at last, and the door is nailed down.

by nature, it presented no particular danger to the public, since it would be far more inclined to stay hidden than to come into the open.

Nevertheless, the search went on without intermission throughout the day until dark. Keepers roamed the woods armed with ropes, lariats and heavy nets. They never caught sight of the antelope.

About noon the next day while the searching party was occupied in a distant corner of the Park, a group of foresters at work outside the Antelope House were considerably surprised to see the rooi rhebok bounding toward them, evidently headed for the open door of the building. They sprang into impromptu action with ropes jerked out of the trees, pressed the animal into a corner of the fence, and trussed it up in a twinkling.

That incident illustrates a trait of animals in zoological collections that is frequently noted. Almost invariably they don't want freedom when they get it, and sooner or later circle back to the place where they know food and water will be waiting. Indeed, it is a common practice for keepers to leave the door open for escaped animals, and often they return of their own accord.

Alice, the big Indian elephant, was a costly example of that trait two winters ago when she reentered the Elephant House by smashing down the front door after escaping during the night because a clogged drain let icy water back up in her stall.

The ease with which animals are handled depends chiefly upon their temperament, with bulk a secondary consideration. A four-ton elephant would probably be less trouble to handle, in case it had to be shifted from one side of the Elephant House to another, than a fifteen-pound king cobra that needed to be transferred to a cage twenty feet away. Temperament makes most of the antelope group particularly troublesome and their keeper has reason to be thankful that they rarely have to be caught up.

"We've had to do it a few times," said Keeper Kress. "Generally you set a crate up outside the door, and then a couple of men with boards go in the stall and keep edging the animal toward the crate. Pretty soon he gets the idea and goes in. That is, some of them get the idea. We had to crate a Kudu once and that wasn't any fun. Look at those big horns! He knows how to use them, too. Well, we threw a lariat around his neck and pulled him down, and then we just pushed him into the crate. But it was a tough job. You drag, push and pull until he gets in, and then you lift the rope off his horns with a long hook.

"Some of our giraffes have been old circus animals, and they handle as easily as a baby. They're used to it, you see. But sometimes they're skittish. We had one that wasn't used to being led, and we had a tough time getting a halter on it. The way you do it is to have the giraffe bend down to eat out of your hand, and then you throw a halter on in a hurry. You try to, anyway. We had one giraffe that wouldn't come in out of the yard without being led in, and every night we had trouble getting a rope into the halter. The animal would bend down to eat out of my hand, all right, and sometimes another fellow would make a quick pass and get a rope snapped into the halter ring. Sometimes he'd miss, though, and then it would take another half-hour's coaxing to get set for another try. I finally rigged up a short loop and a S-shaped hook that we could catch the halter with almost every time."

The routine problem in handling animals around a zoo is not likely to be one of catching an escaped animal or even getting one into a crate. The tricks that call for the most ingenuity are those that have to be performed every day in the course of feeding and cleaning. Keeper Kress illustrated it in the case of the rooi rheboks.

"Now, these two weren't much trouble before the baby was born," he said. "The male got out on me last fall, of course, but the gate's been fixed now and that won't happen again."

He reached around behind him and knocked three times on the handle of a rake.

"It used to be I could go right in the stall and clean it while they were in there. In summer, of course, they'd be out in the yard, but in winter they can't be turned out on bad days. But when the baby came, they got pretty skittish and I can't go in any more—have to work from the door with a long-handled rake."

He illustrated his technique. Keepers' pockets always contain a surprising variety of food and gadgets, and Keeper Kress pulled out a thick slice of bread which he broke into small pieces and tossed toward the rear of the big stall.

The baby rhebok was cradled in a pile of straw toward the rear. The male stood quietly but warily in the middle of the enclosure. The female turned toward the bread and bent to eat it.

Kress whipped the front gate open, inserted his rake, and began working at the floor. The male stood his ground and let the rake play around his feet, but the baby's curiosity was aroused and she struggled up on her spindly legs and ambled indecisively toward the rake and toward the keeper.

"That's always what happens," Kress said. "The baby gets interested. Now watch the female."

At the first sound of the baby's hooves on the concrete floor, she whirled and started toward the rake, ready to fight it. She half-stamped at it, half jumped at it, and Kress had to withdraw it quickly before she injured herself on the tines. However, in the few seconds that were clear for work, the keeper managed to clean most of the floor. Later, when the baby had retired to the rear of the stall, he could finish the job.

Some few of the antelopes are so quick to charge and so handy in the use of their horns that the keeper never attempts to clean their stalls or change the bedding while they are inside. In summer they are turned out into the outside corral; in winter they go out, too, for a few minutes, or—if the weather is too bitterly cold and they cannot be turned out at all—the cage simply remains uncleaned until the next day.

"The bongo and the okapi and the giraffe stay in all winter, but you can go right in and work with them," Kress explained. "That doesn't mean it's very comfortable working with the bongo, for instance. She's got a mean pair of horns, and she keeps edging around me while I'm working. She always wants to be behind me, and that's just where I don't want her to be. I don't think she means any harm, but I feel better about it if I'm between her and the door every minute. Generally I put their feed in the back of the stall, and they stay back there while I'm at work up front."

Deer running at liberty on the ranges can be handled in a variety of ways, but mostly they are variations of the technique of trapping with food. Over a period of a few days the animals may be induced to feed in one of the small shelter houses, or in a small yard, and then at feeding time, when the particular animal that is wanted has gone inside the door or gate is shut and he can be roped.

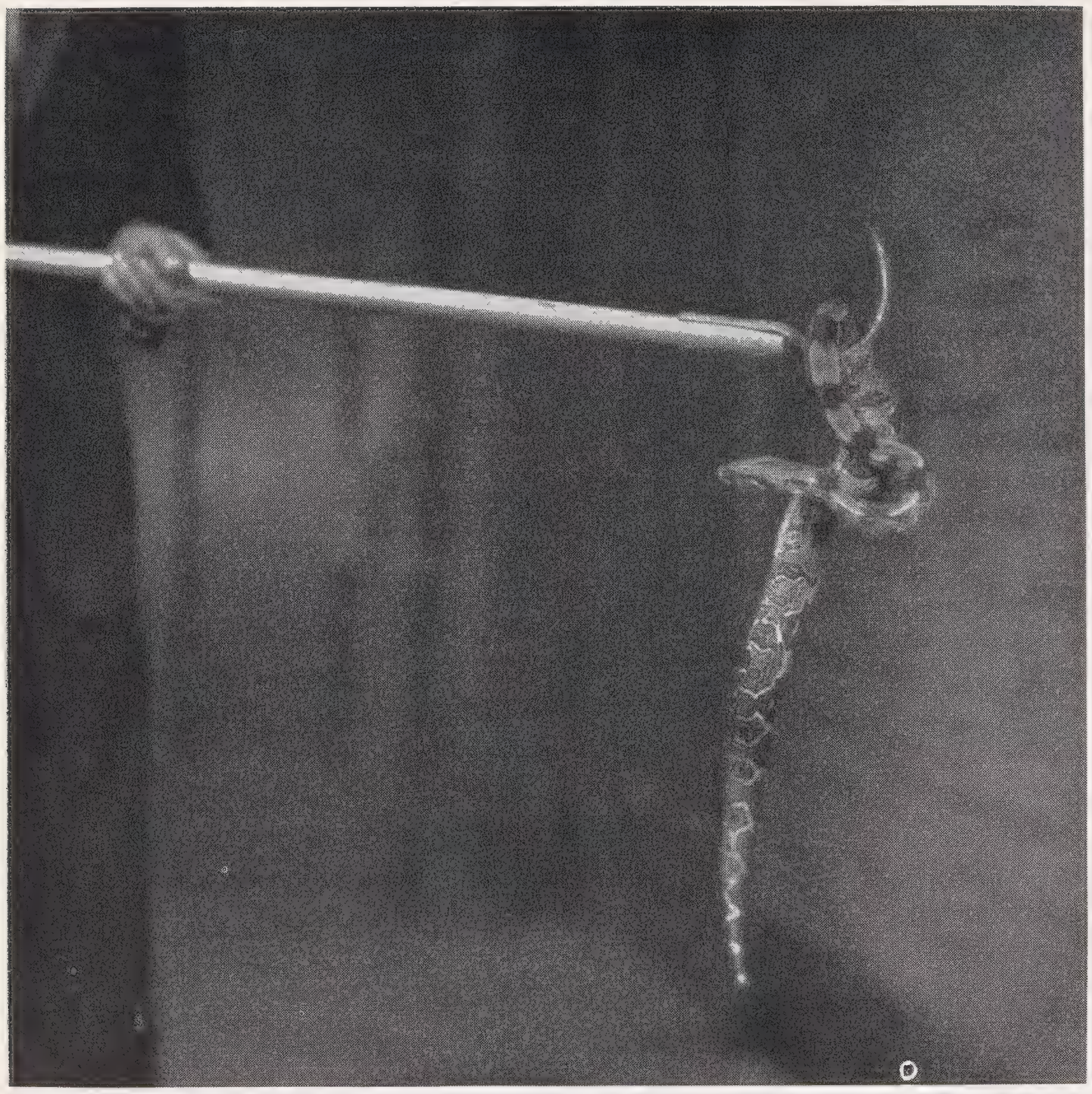
Any keeper who can swing a rope adeptly is in great demand at times when surplus stock is being caught up for sale or exchange with other zoos. Some of the men are expert in tossing a loop over the horns of tahr, mouflon and aoudads after they have been drawn down by food from the rocks of Mountain Sheep Hill to the flat area along the fence.

Baited box traps are generally successful in catching up any of the carnivores that are wanted, although an occasional animal will outwit the keepers. During the past winter one of the research problems of the Laboratory concerned saliva, and a sample was desired from an European wolf. Offhand it seemed necessary only to set a box trap in the wolf den, prop its door open, and tie a chunk of meat to the trigger. The trap was duly set—and the next morning the gate had been dropped, the meat was gone—and the wolf was still trotting around his enclosure.

Night after night the trap was baited and morning after morning the meat was gone and the wolf was still outside the trap. Somehow, by a method that was never quite understood, he managed to steal the meat without being trapped. The experiment was dropped, as far as wolf saliva was concerned.

The simple devices of nets and ropes are of little use when such dangerous carnivores as lions, tigers and other inmates of the Lion House have to be caught up. In such cases a small, portable cage is set up in their quarters while they are locked out, and then they are trapped by baiting it with meat or by inducing the animal to retreat into it ahead of a stream of water from a garden hose.

One dramatic occasion some years ago when a tiger got a sliver of bone caught between his teeth was one in which the Lion House keepers had to work fast and hard. They locked the animal in the small compartment between the inside and outside cages, set up the portable



Snakes generally do all they can to help someone who picks them up gently and easily on a "snake hook." They will throw their bodies into fantastic loops in order to balance themselves and avoid falling off.

cage, and rolled back the door. The pain-maddened tiger bounded into the small cage and its door was dropped. Within a few minutes the Veterinarian had slipped a pair of forceps between the bars and extracted the piece of bone—to the vast and immediate relief of the tiger—and the whole operation was over almost before the animal knew what was happening.

Like the Bird House men, the keepers of the Primate House rely chiefly upon hooped nets on long or short handles when any of their tougher charges are to be captured. For the larger monkeys and apes, of course, the "nets" are stout canvas bags, for many of the larger primates are strong enough to tear apart any net they could get their fingers into.

Snakes are perhaps the most cooperative of all the inmates of the zoo. With a few exceptions—of which the green mamba that now graces the collection was a spectacular example—they readily allow themselves to be picked up on the long-handled "snake hook" that is used when poisonous species have to be handled.

In theory and generally in practice, snakes lie quietly when the small door at the back of their cages is opened and the snake hook is inserted under their coils. They allow themselves to be lifted, so long as the motion is gentle and easy, without wriggling off—indeed, they usually balance themselves perfectly to keep from falling.

Not so the green mamba, a sinuous streak of green lightning. The first time the blunt end of the iron hook touched its folds, it shot out of its cage, bit the edge of the wooden box into which the keeper had been hoping to deposit it—and shot back into its cage. One experience of that kind of speed and temper was enough, and a box trap baited with a dead mouse was set up and the mamba was captured in safety.

Sudden, black storms come rolling, now and then, down from the great mountains back of the Costa Rican bays. They may bring the elusive scents of strange jungle blossoms—or occasionally a hint of sulphur fumes from the outpouring gases of distant volcanos.

A Day in the Bay of Piedra Blanca

Theoretically It Was a Day of Rest, but It Was a Busy and a Profitable One for the Collecting Party from the *Zaca*

William Beebe

THE western coast of Costa Rica is dappled with volcanos. Some are cold and dead, their lava lifeless stone; others are molten and fiery at heart, sending up billowing clouds of smoke and gas—rhythmically or spasmodically. Still others have settled slowly downward, become filled with the waters of the Pacific, and changed their names from Craters to Bays.

On the first day of February of last year, the *Zaca* steamed into one of the most beautiful of these bays, and in late afternoon, in perfect calm, our anchor chain ran out and came to rest on the bottom of the Bay of the White Stone—Piedra Blanca. I never recall a time when calmness of water was so appreciated by both ourselves and the crew. For three weeks we had been badgered by the ceaseless Papagayo wind and on this very day, off Cape Velas, we had encountered its last effort, a squall which rose to Force Nine before it died away.

A quick survey in the launch before dusk showed that we floated in the center of a very lovely symmetrical horseshoe of encircling crater, with a little hut at one end of the mile wide bay, and dense jungle beyond a beach part sand, part bold, piled-up rocks and cliffs; on the whole a perfect answer to a naturalist's prayer. The water was sheer mirror and the

This pool in the inner angle of our bay produced the amazing number of 2,459 specimens of 44 species of interesting Costa Rican shore fish. One never knows what is going to turn up in such a pool—and this one produced two individuals of a new species of pink-spotted anglerfish.

gold and scarlet sunset might have been a terrific volcanic outburst far out at sea, throwing into black silhouette the great sentinel of Piedra Blanca. Its beauty—but at this moment my trolling line was jerked almost out of my hand and a great sierra mackerel leaped high into the air. He was quite two feet in length, full of fight, and by the time I had pulled him in and landed him my sunset had softened to violet and old rose. A new magic was wrought by the golden sliver of a crescent with the whole full moon oxydized but quite clear within its horns.

The roe of the fish was brought to me when we returned to the yacht, and after careful estimate of fractional relative weight, I was rather aghast to realize that my brief, mid-sunset sport had cut short the potential lives of one million, six hundred and eighty thousand infant sierra mackerel! The mother mackerel appeared for the last time as a delicious filet at dinner. Later, as we sat peering through the darkness toward the unknown shore, the clear, high chirping of jungle crickets came across the water, and then from a great distance, the ululations of the wildest, most sinister sounds uttered by any animal on any continent—the coughing, resonant, grunting roars of a full-grown male howling monkey. If anyone can hear the chorus of these animals unmoved, then he should confine his travels within the range of taxihorns and the clangor of elevated trains.

At nine o'clock the night light went overboard and the succeeding hour yielded us an interesting catch. We were anchored in seventy-five feet of water, so the effect of the light did not reach to the bottom, yet ninety per cent. of the fish which came were blatantly nursery—so young that it would seem more fitting for them to be hidden among the interstices of the coral far below. Yet here were mullets, sergeant majors, puffers, gerrids and even clingfish, together with a host of yolk-carrying, unknown infants—all apparently wandering about in the grim darkness near the surface of this open bay. As surprising as the complete ending of the Papagayo wind was the absence of sea snakes. Not a single yellow and black ribbon of life came into view, although they were abundant at Braxilito Bay, our last stop.

High tide in Piedra Blanca submerges all the pools and leaves exposed only the barren bases of the cliffs. The terrific storms which, in their season, sweep the Pacific, scour these rocks of almost all forms of life. In the distance looms the "White Rock"—Piedra Blanca.

Low tide in Piedra Blanca Bay, however, exposes a happy hunting ground for the student of rare fish and crabs. A quart of lethal chemicals poured into the upper end of one of these long rock canals will soon send all hidden fish flopping out on the rocks.

The hauling of a seine or poisoning of a pool is a signal for the frigatebirds to gather, dozens of them, from the highest heavens and distant bays. They watch and poise, swoop and swerve, and finally pick up a floating fish with a skill perfected over thousands of years.

Sunday, the sixth of February, was our last day in Piedra Blanca, and a typical Day of Rest, as we Zacians interpreted it. The following account of the activities of this day is taken from my Journal, quite unchanged except for the addition of a few clarifying parentheses. All details and descriptions of our scientific observations and collections were recorded elsewhere.

"Early in the morning we three (John Tee-Van, Jocelyn Crane and myself) were towed to the pointed rock at the east finger of the crater. On the way a big swordfish leaped near the entrance of the bay; we passed a sleeping turtle and a pair of snowy egrets. In the pram I jockeyed back and forth as near the swirling, pounding water as I dared while we let off three sticks of bong-bong (dynamite). Among the pailful retrieved was a golden yellow puffer and a half a hundred Apogons (cardinalfish) new to us. Landed, and around the point worked the pools with excellent results. In one pool Jocelyn found a big Mnierpian blenny which had partly swallowed an Ophioblennius, the posterior half of the latter in turn being ingested by a sea-urchin. After photographing, we watched for five minutes, and seeing that the urchin was winning I decided in favor of the fish.

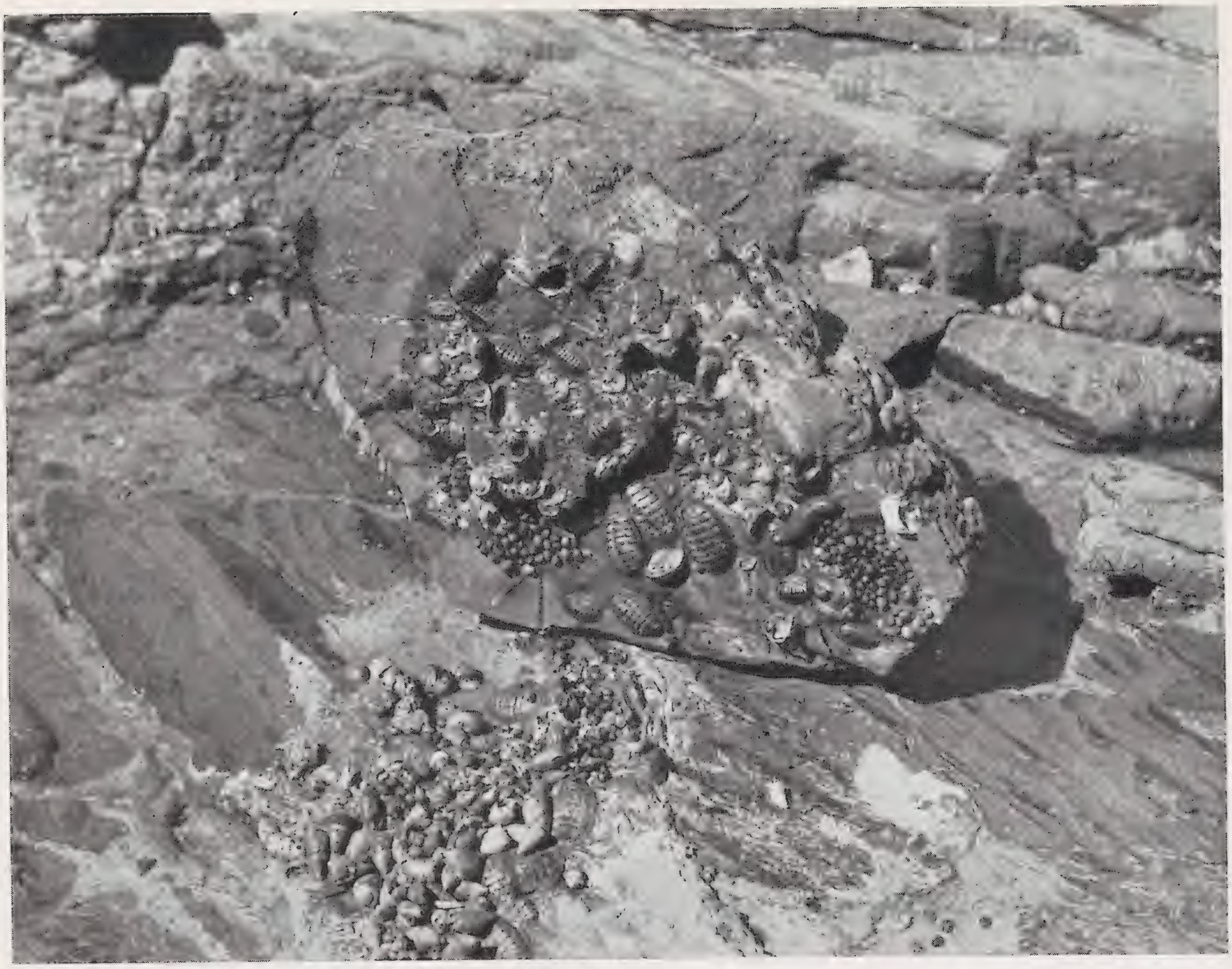
"Back in the sheltered cove beneath the jungle and the dried-up rio, poisoned a pool and got two more of the new species of Antennarius. So like in mottled color were they to the pink, encrusting growths of sponge, we should never have found them. When they began to feel badly they turned belly up and became patches of bright orange and black. Templeton discovered the first specimen of this as yet unnamed species, yesterday.

Only the tent-like shells of the giant limpets can withstand the pounding surf, as the tide slowly covers them, and later recedes to leave them exposed again. Each mollusk has a special form, etched by acid in the rock, exactly fitted to the edges of the shell.

"We ate lunch, waiting for the tide to go down, in the shade of solid masses of Flor de Cortez and white frangipanni blossoms. A small native boy suddenly appeared, wading about apparently looking for edible shellfish. At last he discovered us, but when he caught our eye he turned quickly away and throughout a long walk over sand and around rocks he did not look again. The *Zaca* was probably the first vessel of any size ever to anchor in this bay; we were like a circus, movie and radio, all in one, in his daily life. Yet he never looked again—the innate courtesy of the ancient Spaniard with the shyness of the modern Indian controlling him. After lunch I walked out and spoke to him. He greeted me with a shyness that hurt, and then suddenly rushed up to me, and seized my hand with a *'Bueros dias, quital amigo'*, and looked up at me with the most charming smile I ever remember. (As we went southward the Spanish *n* tended to become *r*.) His name proved to be Clemente Rosalez and the *'quital amigo'* seemed to be construed as 'well-received friend.'

"His shirt was little more than a 'button an' frill', but the pieces which had been sewed in, whole sections, had been matched so that the dark lines of the pattern were continuous. His battered straw hat was caught up at one side with a bit of colored cord. The less said of his trousers the better; at best there was only one leg to them, perhaps a Costa Rican's concession to shorts. Clemente had fourteen years, had been to San José once and wondered if he could not catch crabs and fish—*congrejos y sardinos*—for me so I would have sufficient to eat.

"Later his father came and begged for *quin-*



Here and there large stones offer sanctuary to a host of living creatures. Every available inch of the under side of these aquatic bomb-proofs is occupied by chitons or armadillo shells, worms, sea cucumbers, whelks, mussels and serpent starfish, all crowded together.

ina. He had lived at Santa Cruz until three years ago and had had plenty of tortillas and other things which make life worth while, but his wife had been ill and the priests had taken all his money. There was no bitterness, just a statement of fact. His wife looked pure Indian and the little girl was as keen as her brother.

"I looked over to where Jocelyn was kneeling in the midst of the great intertidal sandy expanse excavating at arm's depth some unfortunate crab. When I looked again five minutes later, an infant pig, an equally juvenile dog and the Indian mother of Clemente were all enthusiastically at work on a quartet of holes, each probably inspired by some abstract, individual purpose. I could not recall ever having seen a more comic sight until, soon after, I saw them all set off for the lagoon together and their travel was as funny as their digging, all in single file, in perfect alignment: Jocelyn, R. padre, R. madre, R. niña, perrito and puerco.

"Templeton brought out a netted, Christmas stocking half full of toys, which I gave to Clemente with injunctions to share them with the little children fearfully watching us from the house on the hill, and soon we heard them blowing penny trumpets. Clemente begged the half empty tins of sardines and discarded crusts of bread as well as two used paper cups, and was speechless with joy when I gave him five small fish hooks. Jocelyn gave the mother an empty quart jar with glass cover which was beyond price in the shopless, mountain-bounded strip of shore. When we returned to the *Zaca* we found that the last, large poisoned pool had yielded about eight hundred fish of twenty-seven species.

"In late afternoon we three took a last walk

When a large stone is turned over to expose the teeming life of the underside, dismay fills this small world and all the inhabitants creep and crawl, as fast as they can, beneath the new sheltered side. Here is a thriving colony of whelks, with a few sea cucumbers.

along the west jungle trail, past the giant trees looped and draped with lianas and cereus. In places the ground is covered with fallen wild poincianas, frangipannis and tassel flowers. Tracks of tapir and deer and some small cat dotted the muddy places and we jumped a peccary. Three lovely squirrels — grizzled gray above and rich rufous below—were making a terrible racket over a small snake. A few mosquitos, but no ticks or bête-rouge. Stopped for a time under the flowering balsa trees among whose branches, three days ago, I had identified twenty-six species of birds, including eight hummingbirds. I now added six more, rufous cuckoo, trogon, redstart, grassquits, euphonias and bat falcon.

"At nine o'clock at night, miles out from shore, when again the slender moon had followed the sun into the Pacific, we stopped the engines for our regular night light work. Before we had lost way the darkness was filled with the soft sounds of a multitude of dolphins. All around us they silently rose, sent out a sibilant, spray-filled sigh and noiselessly sank again.

"Small flyingfish, shrimps, millions of copepods and oikpleura came at once, and were followed by regiments of squids, small and large, which kept the illumined water murky with their barrage of ink clouds. When we were again under way, and our eyes had forgotten the glare of the light, the tropical stars came down until they seemed just to clear the tips of the masts, in perfect order as mankind has always found them, the North Star low down, the Southern Cross recumbent and well up. The oblique, cosmic circle of circles was blazing: Aries, Taurus, Gemini, Leo in full view, and most appropriately for us, Cancer and Pisces."

Fish Out of Water

By a Variety of Adaptations a Few Are Able to Leave the Ancestral Seas and Live for a Time on Land.[1]

Ross F. Nigrelli

THE world presents an almost infinite variety of organisms. Just how this came about has been a speculation for a great number of years among scientists, who speak of it in terms of evolution. It is generally agreed, however, that all life on land originated from the sea, for it is well known that at a relatively early period the surface of the earth was largely or wholly covered with water. In the great migration from an aquatic habitat to a terrestrial one many changes in form had to occur and even today among all living vertebrates, at some stage of development, there are reminders of our ancestral home, the water. This is especially shown by the fact that all vertebrates, from fishes to man, develop "gill" slits. In fishes and certain amphibians this structure remains as a permanent and functional organ while in the higher forms of life it is only temporarily used or transformed into an entirely different structure, serving a different purpose. For example, one of the gill slits in higher vertebrates is modified to form the Eustachian tube which leads from the pharynx to the middle ear. There is other evidence of our former aquatic life, but this need not be mentioned here.

It is evident that all forms of life did not leave the sea. Some, however, tried out being "landlubbers" but gave it up and returned to the water to take up their entire or partial existence in the old homestead. Mammals such as seals, whales, porpoises, manatees and dolphins were formerly land-living animals. Now they spend all of their life in the water. Among the reptiles we also have some that yearned for the old aquatic life—turtles and sea-snakes. Others, being true pioneers and adventurers dissatisfied with conditions in the hometown, stayed on to build new communities on land. Those coming from a hardy stock were able to survive the conditions imposed upon them by the new environment, but the weaker ones soon perished and have since become extinct. The only knowledge that we have of their former existence is by their remains (fossils) found in various earth strata. The amphibians, on the other hand, could not make up their mind just what to do, so we find them moving back and forth from land to water. Others did not have the wanderlust in their blood, so they remained in their watery home, perfectly content with their surroundings (certain salamanders).

Except some amphibians, all these animals are true lung-breathing organisms. If we are to believe in evolution and if our forefathers originally lived in water, who, then, were they? One of the clues to our origin is the gill slits. Since fishes are the most primitive of animals to show this structure as a functional unit and since it is constantly found in early developmental stages in all forms of life above fishes, we naturally assume that the direct line of evolution took place from fishes, to amphibians, to reptiles and finally to mammals. The birds are considered an off-shoot of the reptiles. Some evolutionists even attempt to trace back our ancestry to microscopic amoebulae, but that is going back a little too far. It is sufficient to say that there is good evidence that the progenitor of all land vertebrates, both living and extinct, was an animal with gills and fins.

The first modification that the fish had to undergo in his transformation from an aquatic

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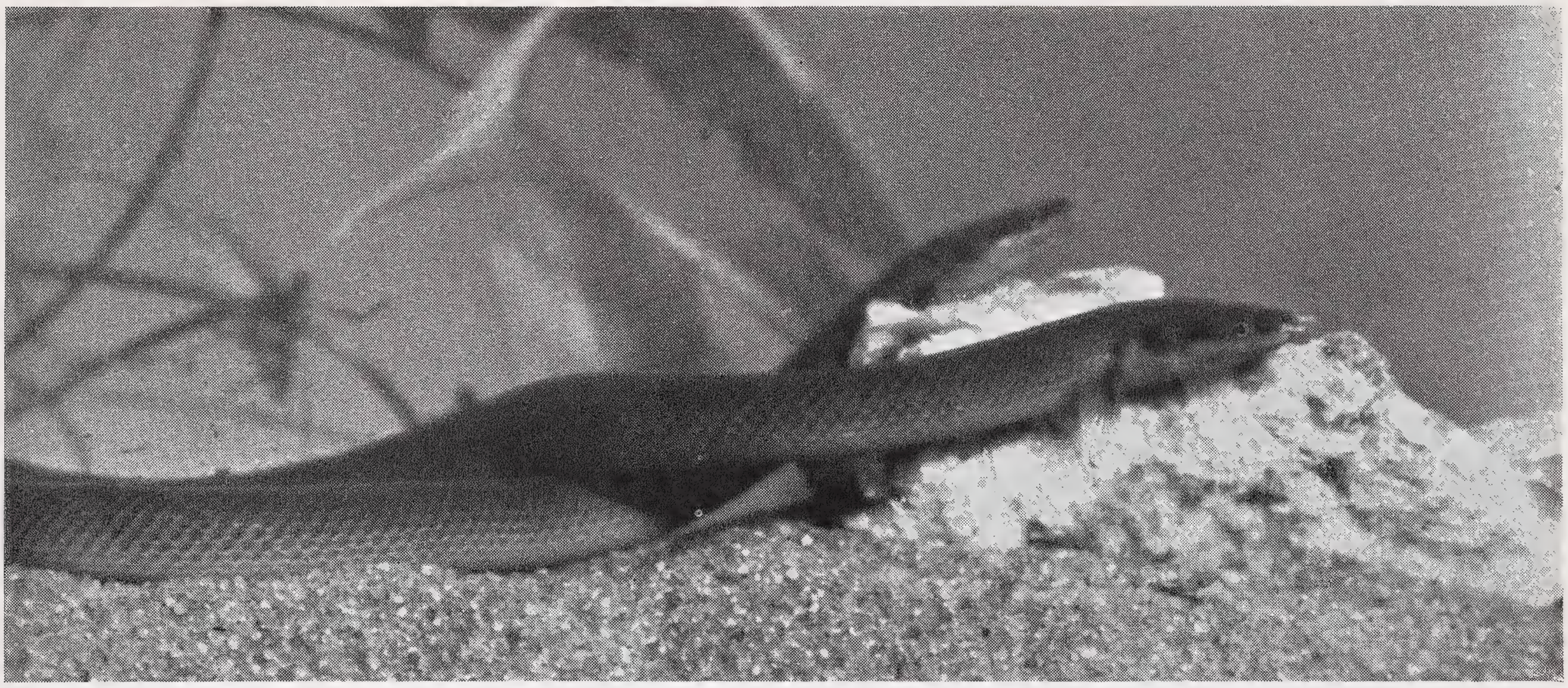
[1] The writer wishes to thank Mr. J. Atz, of the Aquarium staff, for his helpful suggestions in the preparation of this article.



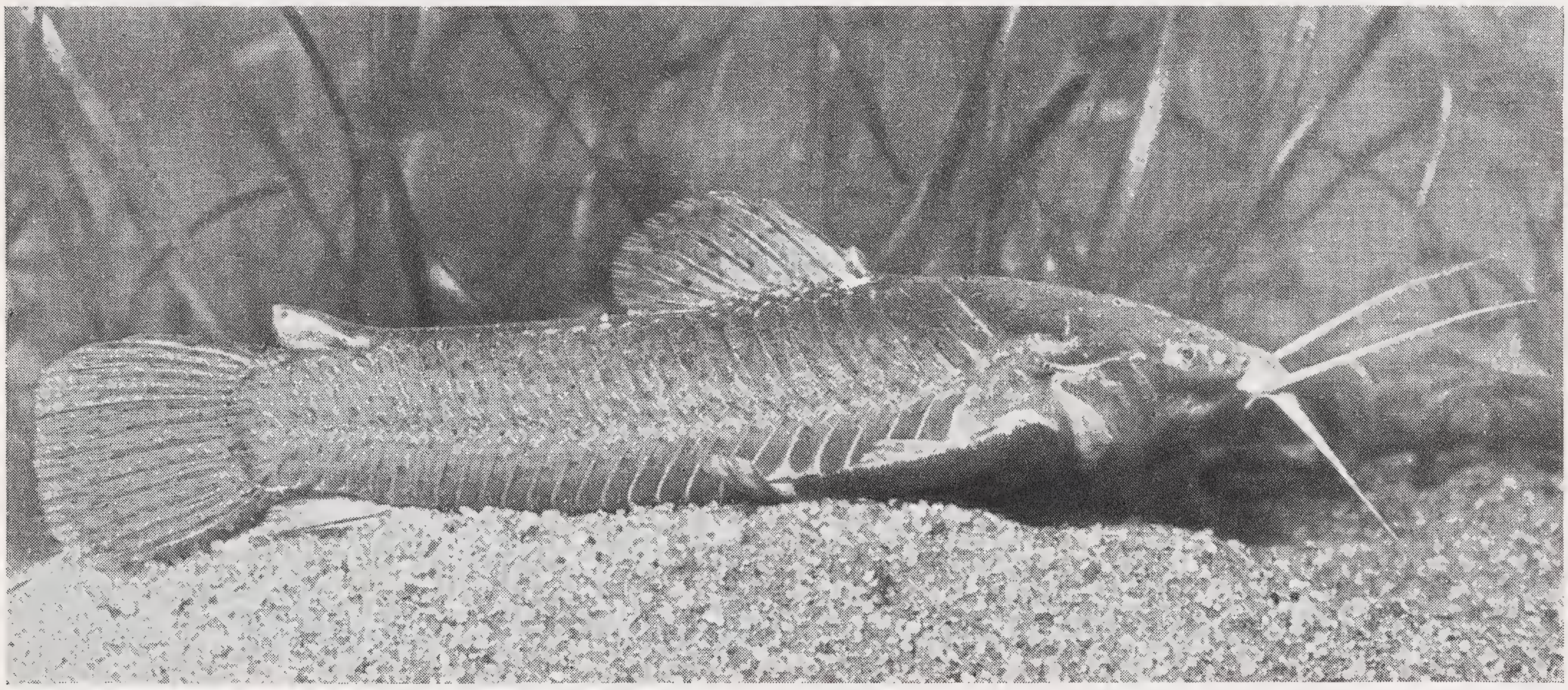
In the evolution of fishes, the African Reed Fish (Calamichthys calabaricus) occupies an interesting position, because it is the present-day representative of an extremely ancient group. It does, indeed, appear to be the forerunner of the true Lungfish that exists today.

to a land-living form took place in his respiratory mechanism. In other words he had to develop a structure that was capable of extracting oxygen from air to replace the one that could function only in water. In land vertebrates the lungs are used for this purpose and in fishes gills are generally used. The story as to just how this transformation came about is simple enough. Most fishes have a structure known as the swim-bladder. The main function of this organ is a hydrostatic one; that is, to keep the fish afloat at certain levels. In many species this bladder is a closed sac and in others it opens into the digestive tract. Those fish whose swim-bladder is connected to the exterior by way of the digestive tract and mouth sometimes employ the bladder as an accessory breathing organ. The fresh water gars and the bowfins of North America make use of this structure for air breathing and for this reason can live in muddy water deficient in oxygen content. In these forms, however, the swim-bladder is developed as an out-pocketing from the dorsal (back-bone side) part of the embryonic intestine and, therefore, is not the true forerunner of the lungs. On the other hand, such fish as the reed-fishes develop an air bladder from the ventral (belly side) part of the primitive gut. This is the homolog of the true lung and finds its ultimate development among true fishes in such forms as the Australian, African and South American lung fish. These forms can truly become "fish out of water," some species having been kept out of water for more than four years.

This, then, is probably the course taken in the evolution of fish to man. The big change from aquatic respiration to the air type has been accomplished and land existence becomes almost a reality, especially for the lung-fish which leads a more or less "amphibious" life.

There are many species of fishes that make use of other structures in their body for aerial respiration and these structures either aid or in some cases supplant the ordinary gill method of respiration. Some of these are so formed that it enables the fish to leave the water. In the majority of fishes, however, such structures make for survival in an environment that no fish using the ordinary method of gill respiration can live in. We speak of these developed structures as adaptations. Just what part they play in the progress of evolution is still controversial, but nevertheless must be considered as an important factor.

With but few exceptions the majority of fishes capable of breathing air live in the semitropical or tropical countries. Biologists envisage the transformation of fish to a land living form not so much as an unconstrained performance on the part of the fish, but a change of life forced upon them by the drying up of their environment. The age in which four-footed animals first appeared is thought by geologists to have been one of recurrent formation and dessication and would have seen reduction of the lakes to swamps and stagnant pools. Such habitats, filled with decomposing plants and animal matter, mud and silt, and often heated to high temperatures by the tropical sun, are deficient in oxygen or contain high concentrations of carbon dioxide. The fishes that successfully met these conditions were those in which modified gills or accessory organs of respiration were developed.



A remarkable specialization of the intestine enables Callichthys callichthys, an armored Catfish from the waters of South America, to come out onto dry land. When small streams dry up and drive these creatures out, they migrate overland in droves to seek new homes.

There are a few species, living in an environment rich in oxygen supply, that do leave the water. Most of these are marine species that have no special respiratory adaptation, except that they may have modified gills and enlarged branchial chambers.

One interesting "fish out of water" is the remarkable rock skipper (*Andamia heteroptera*). This is a tropical marine blenny which lives beyond the surf line. It has large branchial chambers which are filled with air when on land. The body, at such times, is kept moist by the spray of waves breaking over the rocks. In addition to normal gills this fish has *functional pseudo-gills,* a structure that is present in the majority of fish, but like the appendix of man, does not serve any useful purpose.

Salarias is a related species and is so called because of the long leaps it makes from rock to rock. Still another, called the wolf fish (*Annarrhichas lupus*), common along the English coast, has been known to attack persons wading at low tide among the rock pools.

An interesting group of fishes that can live for some time out of water are the cling fishes. These are curious small, carnivorous marine fishes usually found between tide-marks among loose stones and shells, to which they adhere firmly by means of an adhesive ventral disk. About 50 species are known, from various parts of the world, extending as far north as Scotland and Vancouver Island, and southward to New Zealand.

One tropical goby, *Pseudopocryptes lanceolatus,* burrows deep in pools which it inhabits and lies dormant during dry periods, living through months of drought.

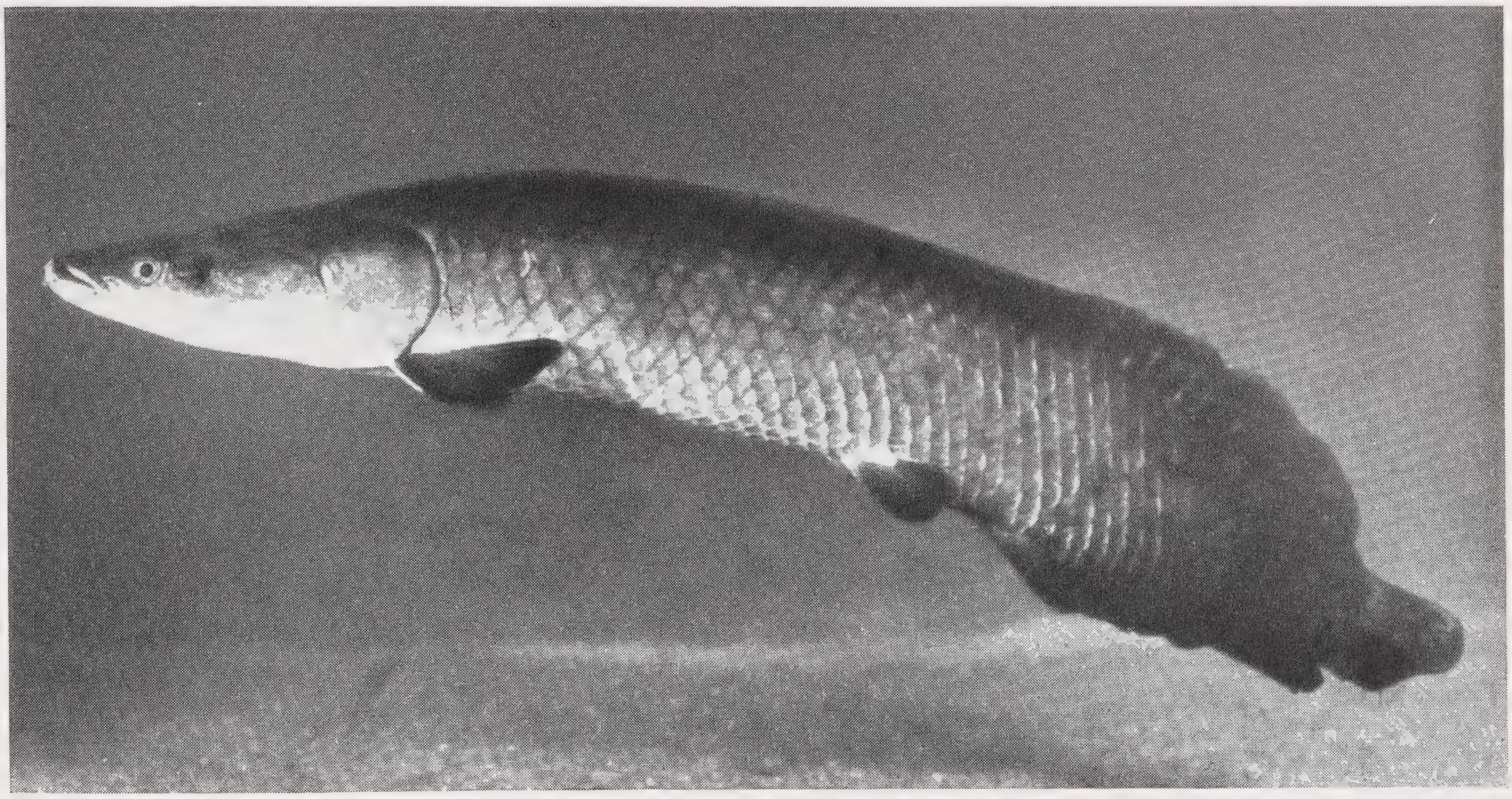
North American fishes like the gar, bowfin and mudminnow, make use of their swim-bladder as an accessory respiratory organ. Such fishes as the giant fresh-water species, *Arapaima gigas,* a South American fish that reaches more than twenty feet in length, also use their swim-bladder for aerial respiration, as does the queer but interesting *Gymnarchus* from the rivers and swamps of Gambia, Africa. None of these species is known to leave the water, but, living in an environment deficient in oxygen, they rely on air for this vital gas.

A group of fishes, especially those inhabiting the swamps of the great Chaco district of Paraguay, make use of either the stomach or the intestine proper as an accessory respiratory organ. It is interesting to point out that the fishes making use of this structure for respiration belong to a group of closely related forms often referred to as South American "catfishes." Examples of such forms are *Doras, Callichthys, Hoplosternum, Ancistrus.* Most of them are common species and are often found in home aquaria. Tropical fish fanciers having these species, and especially *Corydoras,* in their tanks, are familiar with the wild dashes they make to the surface to swallow air. Certain of the loaches also have this ability to use their intestine for respiration. In one European intestinal-breathing loach (*Cobitis*), the air bladder is so reduced that its hydrostatic function is lost and it has become transformed into a sensory organ. Its outer exposed surface is connected with the skin by an opening between the bands of muscle and conveys thermo-barometrical impressions to the auditory nerves. In some parts of Germany this loach is known by the name of "Wetterfisch."

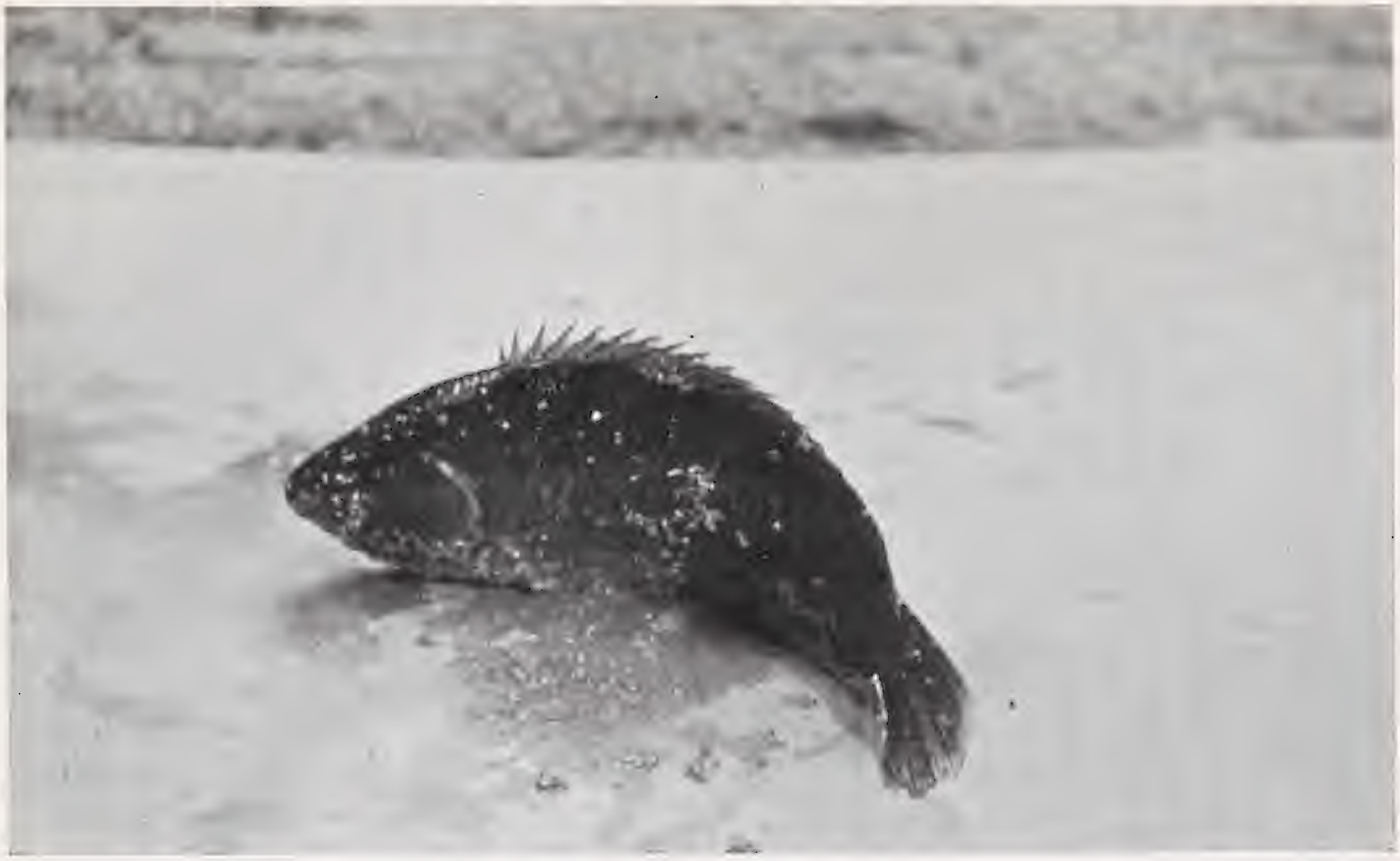
Although the majority of these species do not leave the water, it is not surprising to find certain forms doing it. The first great obstacle necessary to move from water to land has been overcome. The ability to utilize air has been accomplished, so it would not take much of an effort to move on to land. It has been reported by travelers in tropical South America that they came upon "large droves" of small catfishes migrating overland during the dry season. Other intestinal breathing catfishes, belonging to the genera *Plecostomus* and *Hoplosternum,* have been reported as making journeys on land.

Many fishes of the swamps and stagnant pools of Africa and the rice fields of southern China and India, are air breathers. Most of them are characterized by the presence of peculiar accessory respiratory organs known as *labyrinths.* A pair of these is located in cavities above, but close to the gill chambers. They are a series of thin, porous plates, arranged in maze-like fashion and are richly supplied with blood capillaries. Such structures are found in Siamese fighting fish, gourami, Paradise fish and the climbing perch. All of these species, which are well known among fish hobbyists, have been written about in other issues of the *Bulletin* and are always displayed in the tanks of the Aquarium. The first three mentioned do not leave the water but use the structure secondarily to build bubble nests.

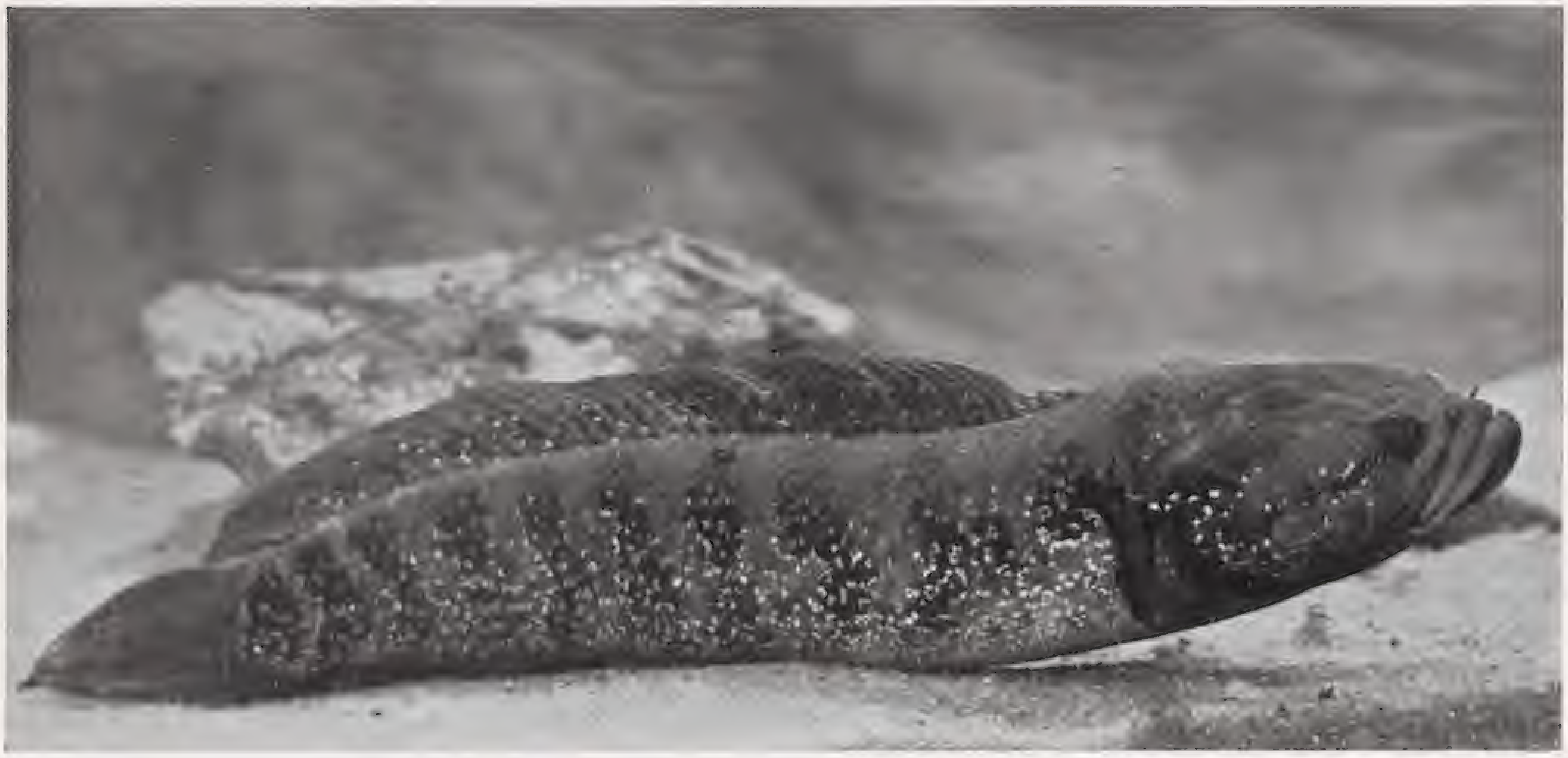
Stories concerning the climbing powers of



This strange fish has no common name, but is scientifically known as Arapaima gigas. It comes from the great Amazon River and is one of the largest fresh-water fishes known, reaching a length of about twenty feet. It uses its swim bladder for air respiration.



This is the famous "Climbing Perch" of India and Malaysia, otherwise known as Anabas testudineus. Although it cannot climb nearly as well as it is supposed to be able to do, it does move overland or seek food on land, having an accessory breathing organ above the gills.



The origin of this fish's common name of "Snakehead" is fairly evident. Channa fasciatus has pouch-like accessory respiratory organs that enable it to live for several days out of water. Orientals make use of this fact to provide fresh fish in inland communities.

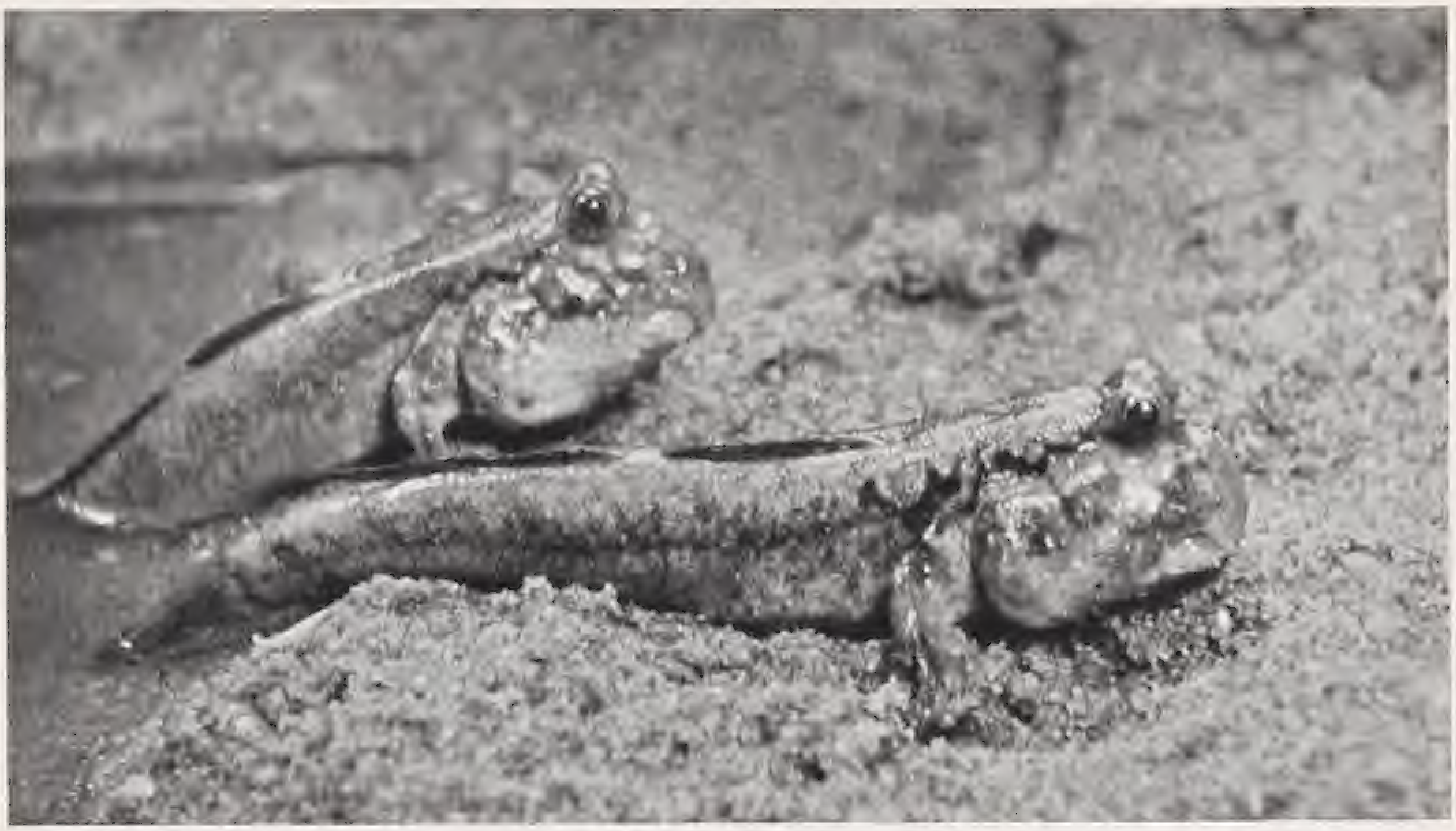
the climbing perch, which is found in pools and ponds of India, Malay Peninsula and the Philippines, were known long before they were shown in the various public aquaria of the world. The famous Indian Fakirs have been known to exhibit them walking on dry ground. According to Hora, the natives consider the fish a delicacy and they were supposed to be "very good for invalids as they are believed to be light, nutritious, strengthening, invigorative and restorative." This common-looking fish has been often reported as climbing trees. It is definitely known that they will migrate over land during the dry seasons so as to reach new ponds and ditches. Naturally, in their migration, the fish will move over the lower branches of fallen trees or low bushes. The forward motion is accomplished by movements of the fins and twisting of the body and tail, and aided by spines on gill coverings which they dig into the ground. Their presence in the higher branches of tall trees is accounted for in two ways; in their overland migration they naturally become easy prey for hawk-like birds and it is entirely possible that they were dropped there by such predators, or it may be that they were dropped there after being picked up by waterspouts, a phenomenon common in such regions and other parts of the world.

Nevertheless, no matter how awkward its movements, the climbing perch (*Anabas*) is one fish that can live out of water for exceptionally long periods of time. They possess the respiratory mechanism necessary to accomplish this feat. Air respiration has become such a necessity that even while they are in the water they must have access to air. Some investigators even go so far as to say that they can be drowned if they are prevented from coming to the surface. These fish, like the lung forms, bury themselves in mud during the dry season and estivate until the rains again appear.

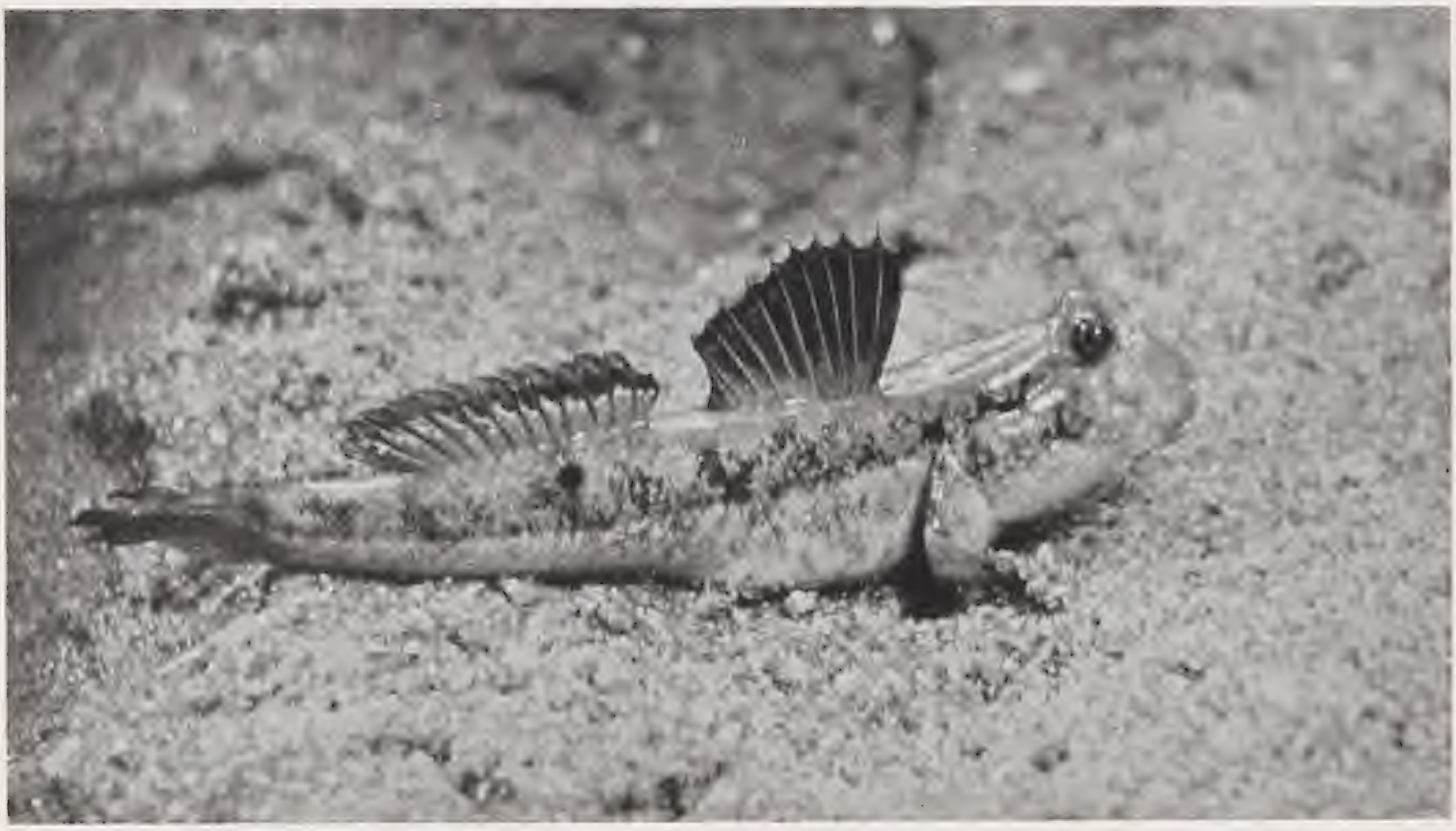
Other species of tropical fishes have lung-like outgrowths either from the pharynx or from the gill chamber. Such fish as the snake-head (*Ophiocephalus*), mud-skipper (*Periophthalmus*) and the eel-like *Amphipnous cuchia* of India and Africa have sac-like respiratory structures in the head, just above the gills. In these forms the sacs are of rather simple structure but in certain Indian and African catfishes (*Clarias* and *Saccobranchus*) the sacs are more or less complex. In *Clarias* the accessory respiratory organ lies adjacent to and behind the normal gills and consists of branched, arborescent and highly vascular tissue. In *Saccobranchus*, a close relative of *Clarias*, two long tubular sacs, which originate from the gill chambers, extend backwards to the tail on each side of the body underneath the muscles but close to the vertebral column. In *Amphipnous cuchia*, an Indian relative of the South American symbranchid eels, the gills are so reduced that only a vestige of them remains. In this species, at least, aquatic respiration seems to be lost.

The vicious-looking snake-heads are a very interesting group of fishes that can live out of water for some time. One species, *Channa asiatica*, inhabits the irrigation ditches and rice paddies of China. When the ditches dry up or are drained this fish simply travels to another more suitable locality. Like the lungfish and climbing perch it will estivate in the mud in times of drought. The Orientals are quite fond of the snake-head and it is often for sale in the markets. Moreover it makes an ideal food fish for a country where refrigeration is almost unknown, because it will remain alive for hours out of water. The buyer need not worry about the freshness of his fish when he can purchase it and carry it home alive in his market basket.

One of the most outstanding examples of a fish that can live out of water is the mud-skipper, or *Periophthalmus*, that lives near the coastal mud flats and mangrove swamps of Africa, Asia and Australia. Many features of its anatomy are indicative of its land adaptations. The pectoral and anal fins are used for crawling over the mud flats and climbing the lower branches of mangrove trees. The eyes are peculiarly adapted for vision on land. These are situated close together on the top of a disproportionately large head. Naturally, the most important changes to permit this mode of existence had to occur in the respiratory mechanism. Although its remarkable out-of-water performances are well known to zoologists, there is some controversy over the method by which mud-skippers breathe. Some investigators believe the tail to be the accessory organ of respiration, and that it must be kept moist or the fish will die. As a matter of fact, most of the old cuts of this particular fish show it sitting on a stone with its tail in the water. Many investigators believe that the enlarged branchial (gill) cavities are filled with air, others that the cavities act as reservoirs for water. The writer has observed the behavior of this fish in the Aquarium and agrees in certain respects with all of these views. When the mud-skipper lies with its tail in the water, neither air nor water need be taken in, but only



The Mudskipper or Mudspringer (Periophthalmus koelreuteri) is a true "fish out of water," for a good deal of its existence is spent entirely out of water, or with only its tail immersed. Just why it prefers to keep its tail in water is one of several mysteries about the fish.



The Mudspringer lives on the mud flats along the coasts of the Indian Ocean. On occasion it does leave the water entirely and sits under the mangrove trees, waiting to spring upon unsuspecting insects. Its pectoral fins are highly useful in locomotion when it is on land.

for relatively short times; when it lies slightly submerged so that its mouth is under water but not its eyes, it will fill the branchial cavity with water and close the small gill openings and rest in this condition for as long as ten minutes. Under similar conditions "normal" respiration with water being taken in and released about twenty times a minute has been seen. When entirely out of water the fish will gulp air but will return to the water to moisten its gills every ten to twenty minutes, or oftener, if necessary. The mud-skipper also has two accessory breathing organs in the form of pouches, placed above the gill chambers and communicating to the exterior by two small openings in the roof of the mouth. It is assumed that when the fish makes long excursions on land, the branchial cavities are filled with water and the accessory pouches with air, the former to keep the delicate gills always moist and the latter for a source of oxygen.

Stomach, intestine, enlarged gill chambers, labyrinth organ, lung-like sacs in the head, air-bladder and lungs are structures adapted for aerial respiration and enable certain fishes to exist in poorly aerated water and on land. But only one specialization was consummately successful. For some reason or reasons only the lung proved to be the stepping-stone to the complete emancipation of the fish from water. The fish with lungs became the *fish out of water* and the ancestor of man.

As the flippers of the whales, seals, penguins and sea-turtles are considered comparatively new adaptations, so may be all the other accessory respiratory organs of fishes. Just what part these new adaptations are playing in the evolution of fish to a land-living form is difficult to visualize. That evolution in general is the result of a series of adaptative changes, has been suggested. It is altogether possible that present day air-breathing fishes may eventually give rise to an entire different group of animals and the adaptation of aerial respiration is just the beginning of a long line of changes necessary for land living.

During droughts, the Lungfishes of South America, Africa and Australia burrow into the mud and secrete a protective layer of mucus. Here a Lungfish is being removed from a hardened block of mud. Lungfishes drown if they do not have access to air; they are true lung forms.

BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

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NOTES FROM THE ZOOLOGICAL PARK, AQUARIUM & DEPARTMENT OF TROPICAL RESEARCH

World's Fair Building

The New York Zoological Society's building at the World's Fair is progressing rapidly and will be ready for the formal opening of the Fair on Sunday, April 30. The building will actually open in advance of the Fair, on Saturday, April 22, to give its staff a week in which to get the exhibits running smoothly.

Spring Party May 18

The spring party for members of the Zoological Society and their guests will be held at the Zoological Park this year on Thursday, May 18—one week later than the usual time, which is customarily the second Thursday in May. By delaying the party a week we *hope* to run into better weather; in any event, it could not be worse than the weather on Party Day last year, when rain fell all through the afternoon.

An announcement of events at this year's Spring Party will be sent to members during April.

Parasol Ants Are Active

The colony of parasol ants brought back from Trinidad by Dr. Ditmars and described by him in the *Bulletin* of November-December, 1938, has been showing extraordinary activity in recent weeks. At first the ants, being chiefly nocturnal while the nest was small, were rarely seen by visitors during the daytime. In February it appeared that the colony had grown to such size that it could be induced to take over the business of leaf-cutting and leaf-carrying in the daytime.

A strong electric light was rigged over the nest for one night, and the next morning a metal shield was placed over the nest-box, to give a comparative shade. Within twenty-four hours the ants changed their habits from night-work to day-work and were visible at hours when visitors were in the Reptile House. After a few days, the use of the night light was discontinued, and now the ants, while active at night, are almost equally busy in the daytime.

The colony has increased enormously in numbers and at least three fungus beds are growing inside the nest-box. Supplies for the fungus beds are furnished by roses, which are replaced every day. Light-colored roses—particularly yellow ones—are the favorites of the leaf cutters and a bunch of three or four roses is generally cut to shreds in the course of one day and night.

New Arrivals

A baby rooi rhebok, a female, was born to the pair in the Antelope House on February 15, and is turning out to be a healthy, sturdy youngster. For the first few days the rhebok stall was screened and the building was closed to visitors until the parents got used to their first baby.

Another spring arrival is a pigmy hippopotamus, born on St. Patrick's Day. This is the seventh pigmy hippopotamus born in the Zoological Park since the arrival of the first three specimens on July 9, 1912.

Mount Hornaday

A mountain in Yellowstone National Park has been named Mount Hornaday in honor of Dr. William T. Hornaday, first director of the New York Zoological Park, it was announced recently by the U. S. Board on Geographical Names. The name was selected at the suggestion of President Roosevelt, an admirer of Dr. Hornaday's conservation work.

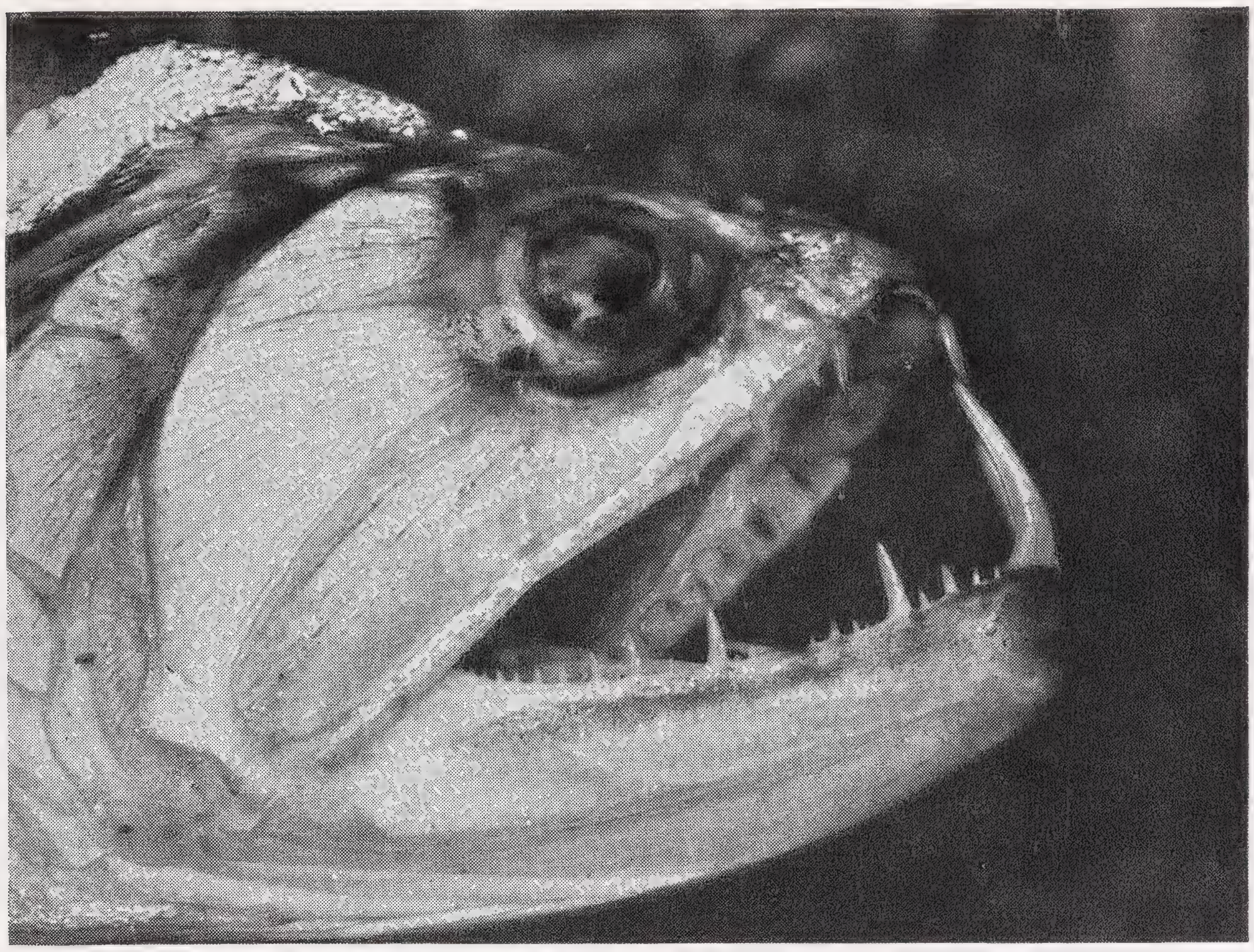
Mount Hornaday, 9,900 feet high, stands at the head of Plateau Creek and is visible from the northeastern entrance road to the Park.

"The American Bison," a history of the animal written by Curator Martin S. Garretson of the Heads and Horns Museum and published last spring by the Zoological Society, will shortly be brought out in a French edition by the publishing house of Payot, of Paris.

Individual specimens of white (albino) raccoons have been seen in the Zoological Park occasionally, but a pair of albinos are now on exhibition in the Small Mammal House.

The new roof of the main Bird House has been completed, and the additional alterations and repairs should be out of the way in time for reopening of the building during April.

A new edition of the Guide Book to the Zoological Park, completely rewritten and containing new pictures, will be issued during April. Of the previous Guide, more than 500,000 copies were printed in the course of twenty-four editions. The former Guide Book was written by the late Dr. W. T. Hornaday, who revised in 1927. The mammal and reptile sections of the new Guide were written by Dr. Ditmars and the bird section by Mr. Crandall. The volume contains 272 pages, which is 48 pages more than any previous Guide, and will sell for 50 cents.



The canine teeth of Hydrolicus scomberoides from the rivers of British Guiana are quite unlike those of most fish. When the mouth is closed, the teeth actually pass through the skull and about a quarter of each tooth projects above the head.

Teeth—Long But Harmless

Teeth—from tapeworms to tigers—await a worthy epical account of their evolution, uses, change of function, rise and decline. Now and then there comes to our attention on one or the other of the expeditions of the Department of Tropical Research, teeth of unusual character. Such are the canines of the dog-toothed fish or silvery biara of the rivers of British Guiana (*Hydrolicus scomberoides*). It is one of the most dangerous looking, yet is a perfectly harmless fish. Its canines rise up and up from the very end of the lower jaw, until, in order for these fangs to function, the mouth must be opened at least ninety degrees. When the mouth begins to close, the teeth do not pass outside the upper jawbones, but actually through the skull. When the mouth is tightly closed, about one-fourth of each tooth projects above the head, clear out into the water.

A deep-sea fish, *Opostomias,* one of the true dragonfish, is known only from a single specimen, taken many years ago in Australian waters by the famous *Challenger* expedition. In this fish the longer teeth also pass straight through the head, penetrating the center of the premaxillary bones.—W. B.

Codfish Troubles

During the late fall of last year one of the large concrete tanks in the Aquarium sprang a leak and it was necessary to remove the giant groupers, which had been inhabiting it, to another tank so that repairs could be made. These groupers are unwieldy creatures, approaching three hundred pounds in weight each, and so, rather than return them to their old tank after repairs had been made, we decided to leave them where they were and put other animals into the tank. This was not easily accomplished, for it is impossible, during the winter, to collect and bring in any large tropical marine forms, and collecting of cold seawater fishes is not easy at this time of year. We did, however, succeed in procuring 21 codfish, *Gadus callarias,* from the fishermen of Sheepshead Bay.

These specimens were all large fish, averaging twenty pounds weight. There were not enough to fill the tank, so a further collection was requested. Eighteen new fish were captured within the week, but unfortunately, all in the last collection were taken in water deeper than sixty fathoms. It is practically impossible to keep fishes taken from depths greater than this and we lost fifteen of the second shipment overnight. The other fish are standing up well, although they do not show well. These creatures must be kept in cold water, which we pump from the harbor, but because of the activities of a dredge operating almost directly opposite the Aquarium, the water contains so much stirred silt that our filters are unable to cope with it and give us clear water. In addition, the cold water inside the tank causes condensation of atmospheric moisture on the outside of the glass walls, so that our collection of codfish, the largest of which we have record, and of which we might feel justly proud, is not nearly as successful as we would wish.—C. W. C.

Fish from Mexico

The Ward liner *Orizaba* arrived in New York on Sunday, March 12, carrying fifteen cans of living fishes collected by Mr. James W. Atz of the Aquarium staff in Mexico. Mr. Atz accompanied Dr. Myron Gordon on an expedition to collect live specimens of small tropical fresh water fishes for genetical work and to study the evolution and variations of the common Mexican platyfish.

Besides a number of platyfish and swordtails brought back for study, specimens of *Gambusia nicaraguensis,* one of the less voracious members of this genus; *Rivulus tenuis,* two unidentified Cichlids, and some fresh-water crabs, all captured near Papaloapan, Oaxaca, were transported for exhibition in the Aquarium.

Although these fishes are all small species, they are very attractive exhibits, the *Gambusia* particularly with its lacy fins and purplish sheen making a welcome addition to our collections.—C. W. C.

Duck Situation Favorable

Wild ducks are increasing in numbers for the fourth consecutive year, the Biological Survey reports as a result of its January waterfowl inventory.

In 1937 the inventory tabulated about 9½ million waterfowl; in 1938, more than 12¼ million, and the survey of the winter concentration areas this present year showed about 14 million birds. This figure the Biological Survey estimates to be about 25 to 30 per cent. of the continent's waterfowl.

"There is a definite general increase," Howard Zahniser of the Survey reported in late March. "But the increase does not hold in every part of the country. We still have need for thinking seriously about improving conditions. In the great central flyway—Idaho, Montana, North Dakota and on south—the ducks are fewer than last year. The geese are down in the states from Washington on south to California and also in the general region that includes Arkansas, Tennessee, Alabama, Mississippi and Louisiana. In fact, we found fewer geese throughout the country. It is the much larger increase of ducks in other sections of the country that brings the waterfowl total so far above last year's figure for the entire country."

The Biological Survey's representative pointed out, however, that "If conditions are not favorable for nesting, the best flights of birds in the spring will not bring an increase in the fall. But if we know that an increase of birds went north in the spring and then found favorable nesting conditions, we can be pretty sure that a good flight of birds will return in the fall."

PUBLICATIONS OF INTEREST

FAUNA. Quarterly publication of the Zoological Society of Philadelphia. Vol. 1, No. 1, March, 1939. 16 pp., illus. Roger Conant, Editor.

The first-founded Zoological Society in the United States has never had a periodical publication commensurate with its importance. The shortcoming has now been corrected with the publication of the initial issue of "Fauna," which supplants the occasionally published four-page news sheet, "The Philadelphia Zoo."

The format of "Fauna" is approximately that of the *Bulletin* of the New York Zoological Society. Volume I, No. 1, contains "Lizard Life and Limb" by Clifford H. Pope, "Bamboo, a Biography of the Zoo's Leading Citizen," by Roger Conant, "The Challenge of Bird Migration" by Norman J. McDonald, a page of miscellaneous "Zoo News," and a page for Junior Zoological Society members, "Keep Your Own Zoo," by George Davis. The cover illustration is a camera study of the Philadelphia Zoo's Sumatran tiger, "Tiang Alam," by Mark Mooney, Jr., the staff photographer.

Planned to interest the members of the Philadelphia Zoological Society, "Fauna" is brightly, popularly but accurately written and plentifully illustrated. Roger Conant, the editor, is Curator of the Philadelphia Zoo, and he has managed to produce a magazine which is striking and competent evidence of the new life stirring in the oldest zoological garden in the country.

BLUE ANGELS AND WHALES. By Robert Gibbings. Penguin Books, Limited, London, 1938. Illustrated with drawings and photographs. 117 pages, paper. 35 cents.

An artist of note discovers the charm of coral seas and is moved to write a little book about his experiences. The discovery happened in Tahiti. Since then he has visited other quarters, sketching chiefly reef fishes, using diving helmet technique to a large extent. From the admitted manner in which the tract was written, one would be lead to expect a thoroughly subjective treatment, especially from the pen of an artist. However, I was surprised and pleased to find the treatment very considerably objective—much more so than a good many of the recent treatments of natural history subjects at the hands of popular science writers. The author, although disclaiming any scientific attitude, had the good sense to confer with various zoologists, with the result that the text is fairly free of questionable biology. This is, however, not a guide book for the naturalist; it is something to be read just for the fun of it. As it rambles amiably along, it struck me that the material was similar to that in the memory of everyone who has poked about in such places and of the kind that one usually does not commit to paper. Consequently I was left with the same pleasant feeling that one is apt to have after a lunch table conversation with someone just returned from a trip and still full of anecdotes. As would be expected, a large number have nothing whatever to do with the sea or its inhabitants. If Robert Gibbings talks as he writes he should be a most engaging companion.—C. M. Breder, Jr.

A FIELD GUIDE TO THE BIRDS. By Roger Tory Peterson. New York: Houghton Mifflin Co. 180 pp., illus. Revised and enlarged, 1939. $2.75.

When the first edition of "A Field Guide to the Birds" appeared, in 1934, it established a new high for "field guides." For while many works of similar intent have been published, Peterson had not only that pearl of pearls, a fresh idea, but the unique ability to develop it. The inspiration rests on the fact that birds in the field have definite distinguishing marks by which the initiate may recognize them at a glance. An impression of form, with a white patch or a black line in just the right place, gives a definite diagnosis of species, without careful checking of each separate feature.

Mr. Peterson has emphasized these "field characters" in flat, accurate drawings, free from unnecessary detail. Usually they are done in perfectly satisfactory black and white, although, as in the case of the gaily plumaged Wood Warblers, colored reproductions have sometimes been necessary. These illustrations are amazingly good and the field characters are strikingly developed.

In the new edition, some rewriting of the simple text has been done, chiefly by way of clarification. Added paragraphs on Voice and Range, under each species, greatly increase the value of a book that seemed little short of perfect without them. —L. S. C.

Serpents of the Northeastern States

By RAYMOND L. DITMARS

HERE is a comprehensive, yet compact, book about the snakes of the northeastern states that will prove to be extremely useful to everyone with a summer home or camp in that region. This guide to the venomous and non-venomous reptiles of the New England area, New York, New Jersey and eastern Pennsylvania, is a practical and handy reference work. It gives a key for ready identification of snakes, descriptions of their feeding and breeding habits, notes on distribution and photographs of every species found in the northeastern states, including color plates of the copperhead and rattlesnake. One section is devoted to the emergency treatment of snakebite.

"Serpents of the Northeastern States" was originally published as a complete number of the BULLETIN and several reprintings were quickly exhausted. It has been republished in a new format, somewhat revised as to text and nomenclature, and four photographs have been added.

60 pages, 41 illustrations. *50 cents postpaid.*

Department of Publication & Photography
NEW YORK ZOOLOGICAL PARK
185th Street & Southern Boulevard
New York, N. Y.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Forty-one volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XXIII are complete and indexed. Volume XXIV will be issued during 1939, in quarterly parts. *Zoologica* is sent to members on request.

[*Zoopathologica,* Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica. Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report, Zoologica* and *Zoopathologica,* as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to Publication Office, Zoological Park, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

Clark and Fritts, New York, Printers.

NEW YORK ZOOLOGICAL SOCIETY

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

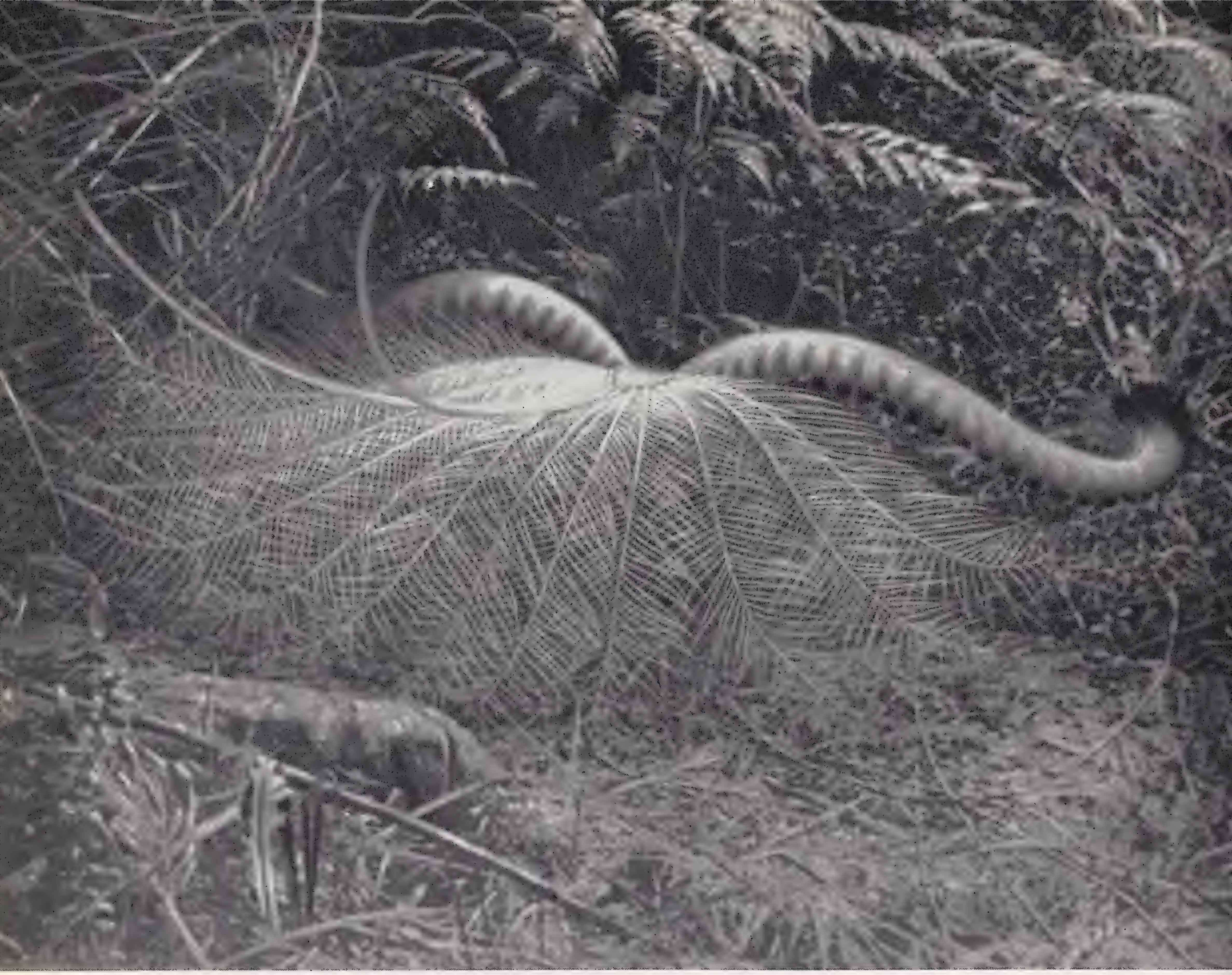
Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



Full display of the Lyre-bird. In the morning sunlight the silvery underparts of the plumes scintillate like delicate mother-of-pearl.

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In the Haunts of the Lyre-bird

Foxes and Feral Cats and Egg-collectors Are Bringing a Famous Australian Bird In Danger of Extinction

John E. Ward

If I were a millionaire, or even a wealthy man, there is one thing that I would like to do. My efforts would be devoted to an endeavor to save from extinction the wonderful and beautiful Lyre-bird (*Menura superba*).

Because of the ruthless destruction of wild life in Australia and particularly of this glorious bird, so emblematic of Australia, much of the charm and interest of our picturesque parks and reserves will be lost forever unless some immediate action is taken for its salvation.

For many years I have watched the gradual disappearance of the Lyre-bird from its ever-narrowing domain. Having been invaded by the settler, the rich, fertile scrublands at the foot of the mountains, where the bird finds most of its food, have been cleared and planted for the apparently ever-increasing needs of humankind.

The depredations of a great pest imported to Australia—the English Fox—ably assisted by domestic cats gone bush, have hastened the disappearance of the Lyre-bird, nor must the egg-collector, with his contemptible hobby of robbing the bird's nest of its single egg every year, be overlooked as another unfortunate factor in quickening the extinction of this unique member of the Australian avifauna.

It is not altogether surprising that the Lyre-bird, a tame and friendly creature, is nearly a thing of the past, considering its native enemies and those that have been introduced.

Although unpretentious and sombre in color, the male bird, when on the mound or dancing ground, as it is commonly called, exhibiting exquisite plumes in graceful contour and with quaint demeanor, to the accompaniment of every songster in the bush, possesses all the attributes that create a joy forever.

My good friend, Lee S. Crandall, Curator of Birds at the New York Zoological Park, has asked me to write about my experiences with this remarkable bird. So much, however, has been written about the adult Lyre-birds that there is little left for me to say. Unfortunately, much of the printed matter regarding the bird is not authentic, being merely an echo of former writers who have made statements that are quite erroneous.

I have no desire to repeat the hackneyed description of the Lyre-bird that appears in many a textbook, but wish merely to record my experience with regard to those events which occurred when I was in search of the nests and nestlings and in the hand-rearing of chicks.

It is nearly fifty years since I obtained my first Lyre-bird chick (*Menura alberta*) in Queensland, the neighboring great State to the north of New South Wales. My experience with insectivorous birds and their feeding had already at that time been extensive, but I little realized the difficult task that I had undertaken in trying to rear a two-weeks' old Lyre-bird nestling. So essentially insectivorous are these young birds that for the first five or six weeks

JUN 17 1939

Photo C. Price Conegrave

In the heart of the gaunt Blue Mountains of Australia the Lyre-bird makes its home. Here the vegetation grows thick and rank and the innumerable gullies offer recesses in which the birds can build their nests. Nevertheless, civilization is encroaching on their domain.

after they have been hatched they are as delicate and helpless as the Australian Wren, to which family it is claimed they are allied. Indeed, anyone who has been fortunate enough to see the antics and display of the Emu Wren during the courtship period would certainly agree that the tiny bird was trying to ape the contortions of its giant cousin.

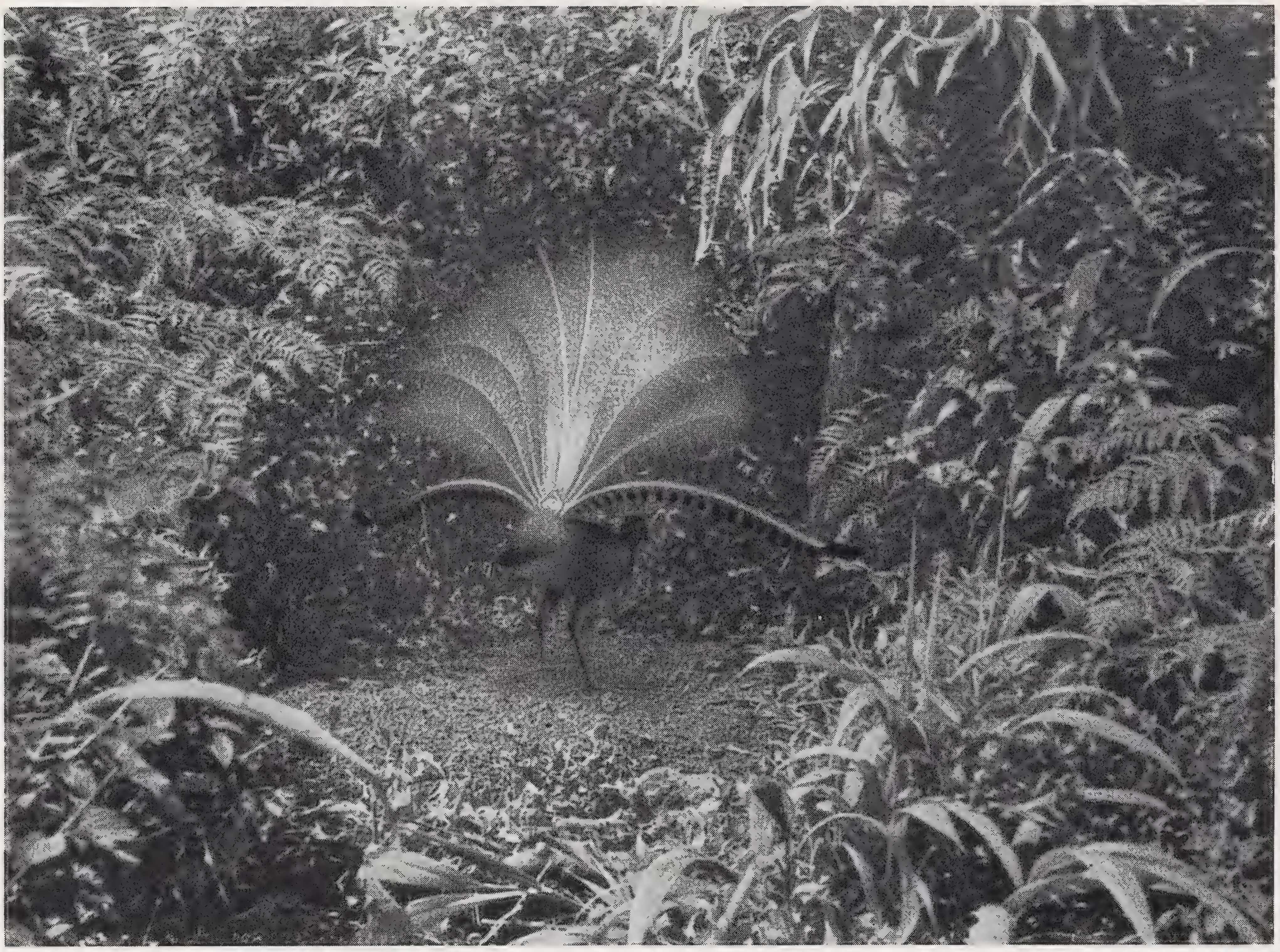
It was midwinter of 1938, in July, when we went to the mountains to search out the haunt of the Lyre-bird in the gullies and hillsides. Being the first bird of the season to nest, the process of nidification was then well advanced. A journey of 25 miles brought us to Kuring-gai, the most easterly spur and limit of the gaunt Blue Mountains, where countless gullies and gorges lead to the many tributaries of the Hawkesbury River. On a hilltop in the shade of a few stunted gum trees we parked the car and proceeded on foot along an ill-defined track, many of which occur along every ridge. They have been worn clear by the pads of many animals journeying to and from their own particular domains in the wild bushland. The vegetation was sparse and rank — saw grass, starved-looking ferns and grass-trees, stunted eucalypts and bottle-brush trees in full bloom. Here were many varieties of Honey-eaters taking their early morning fill of nectar from the flowers by means of their long brush tongues.

Trudging along through the dew-drenched grass and bracken, we watched the pretty Spine-bills as they darted from tree to tree with the characteristic loud flicking of their wings; noisy and quarrelsome New Hollands chased each other through the foliage, their passage causing the dew from the leaves to fall like a thousand sunlit diamonds to the damp ground beneath. Then, as the birds flashed into the sunlight, under a sky of purest cobalt, one could believe that such a scene might not be excelled for exquisite beauty the world around.

A little farther on, where the undergrowth was denser, we lost sight of the "pad." We were pushing on, however, when suddenly something darted across our line of vision. It was a flash of turquoise-blue, opal and maroon, a Lambert Wren uttering its excited, scolding notes at having become separated from its family of four, which with equal noise were quickly following in single file in order to gain safe cover.

Suddenly a pall seemed to have fallen over

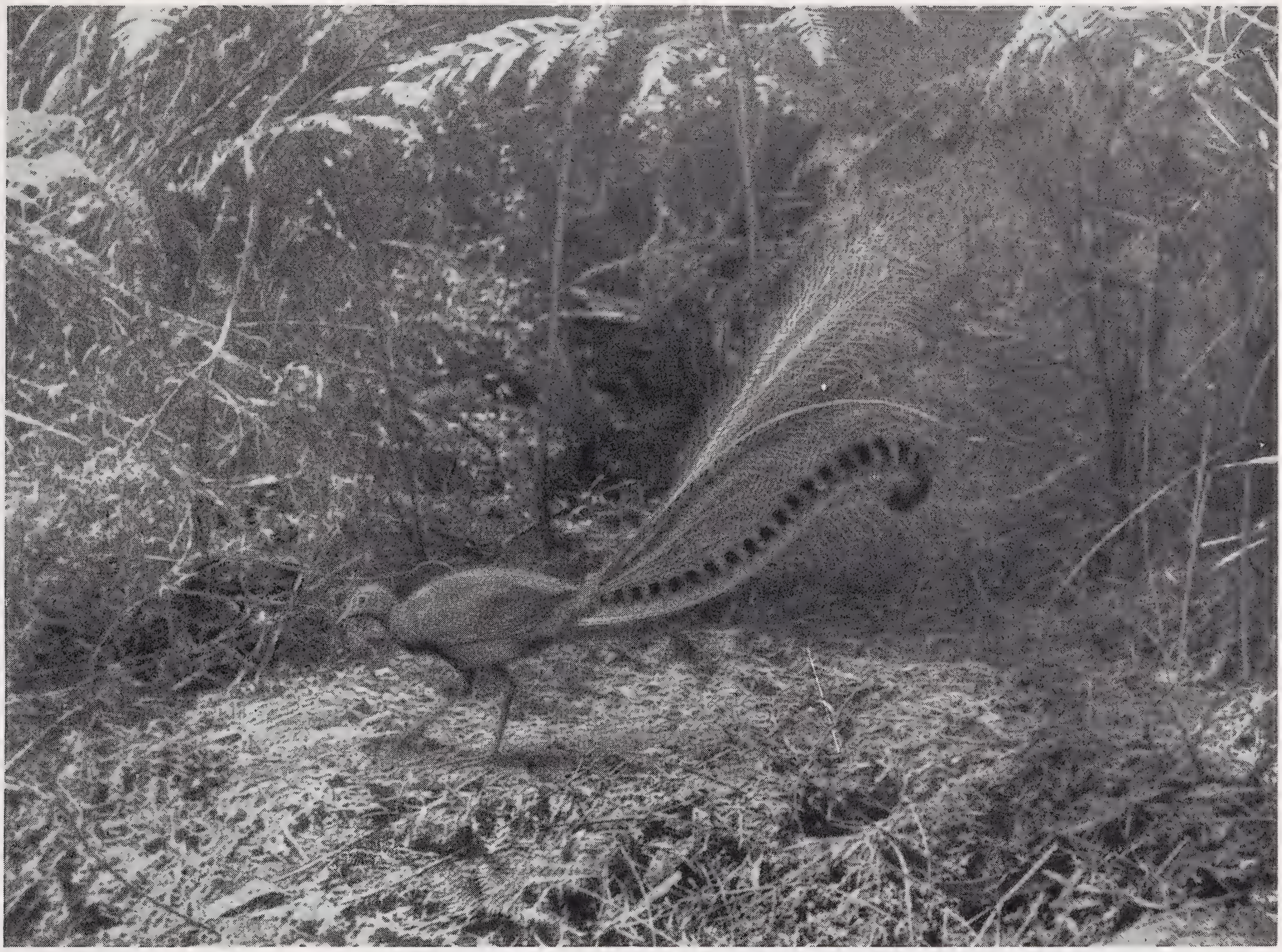
Thousands of just such cascades as these furrow the gullies and gorges of the Blue Mountains, feeding into the tributaries of the Hawkesbury River, and it is in these ravines that the Lyre-bird roams in its never-ending search for insects to feed its ravenous young. It is a scene of great beauty—but one that has many difficulties for the seeker of Lyre-bird nests.



The author cleared away the brush in the foreground to let sunlight onto this dancing mound —and then had to wait several weeks to get this picture of the bird on the mound, for it was alarmed by the altered appearance of the clearing and for a long time refused to display.

the whole hillside. Where were all the Honey-eaters and the Fly-catchers with their gorgeous bursts of song? One glance upward and the silence was explained. A dark, quivering form, like some mechanical device suspended in mid-air, almost uncanny in its menace, was shadowed on the bush where we stood. It was a Hawk. Without so much as a flicker of wings it sailed gracefully over the hillside and was seen no more. Then the bush came to life again as the sweetest of songsters—a Shrike-thrush—poured forth his glorious liquid notes.

Down, down we went into the ever-narrowing gully, jumping from one sloping rock to the other, over which the drainage from the hillside was sweeping toward a tiny, crystal-clear creek many feet below. Great patches of moss of many vivid tones colored the shelving rocks. Here the first traces of the Lyre-bird were seen, for it is an inveterate scratcher. In many places the moss was torn from the surface by the bird's large and powerful claws and loose pieces of rock of extraordinary size were displaced in its search for insects. The surrounding vegetation was now more luxuriant, patches of boronia bushes growing on the boulder-strewn hillside while huge gums and ironbark trees towered overhead. Drenched to the skin from the dew-laden kangaroo grass and undergrowth, we paused to listen to the Lyre-bird's joyous song and mimicry as he strutted from mound to mound, stopping for a few moments at each in order to display his quivering plumes, and then to burst again and again into melody. We crept cautiously through the boronia, hoping to get a glimpse of the bird. From behind a large boulder, ahead and to our right, we would perhaps get an excellent view, could we but reach it without alarming the bird. The snapping of a tiny twig underfoot or a rolling



This is as near the shape of a lyre as the plumes of the Lyre-bird are ever naturally held. As the tail is elevated, the two main feathers spread out fanwise until the plumes are completely reversed over the bird's head, showing the silvery underparts of the tail.

stone would send him scurrying along the escape trail that led to the next mound. With bated breath and pounding hearts we reached the boulder, from where we could even hear the rustling of the bird's plumes. Inch by inch we raised ourselves to peep over the top, into a little clearing between two overhanging bushes where a vine of sarsaparilla in full bloom hung its purple-blue flowers, giving just that touch of soft color to harmonize with the seared grass and bracken in the foreground.

There, not fifteen yards away, was the mound and on it a trembling mass of plumes displayed to their full extent. Turning in half circles, the bird seemed likely to overbalance as it made pretence of scratching and pecking at food. Turning in half circles again and vigorously shaking his plumes, he drew himself up on to his toes to his full height; then partly depressing the tail feathers he stepped from side to side, jumped forward and shuffled backward, opening and depressing his plumes again and again as he strutted and reproducing meanwhile an amazing variety of bush sounds, from the Whip-Bird to the Kookaburra.

As we gazed almost breathless, a pair of Rufous Rock-birds lobbed on the boulder close to us and started to search for insects in every nook and cranny. We gave them scant attention for, at that moment, we heard the measured pat-pat of feet pounding down the hillside with increasing speed. Next instant a half-grown Wallaby bounded past at express speed only a few yards from us. The Lyre-bird, sensing something amiss, lost no time in seeking cover. We followed the bird's trail along a well-beaten track through the grass and short brush, and found another mound not more than twenty yards further on. We came upon others along the ridge covering altogether several hundred

Underneath the ledge of rock in the immediate foreground a nest was finally discovered. Often the whole side of a mountain is as broken and precipitous as this, each nook and cranny offering a possible site for a nest. Finding one is largely a matter of searching systematically.

yards, some only a few yards apart and others at quite a distance. Each mound was scrupulously clean, not a leaf or twig being allowed to mar its even, sandy surface.

Knowing from past experience that we were not likely to find a nest in the immediate vicinity of this dancing mound, situated as it was on the sunlit side of the gully, where the earth was too dry and infertile to supply the vast amount of insect life required to support the needs of mother bird and chick for the next three months, we decided to cross over to the more shaded side where in some cool nook the birds would be more likely to build their nest. But here it was so precipitous that in order to make a crossing we were forced to retrace our steps.

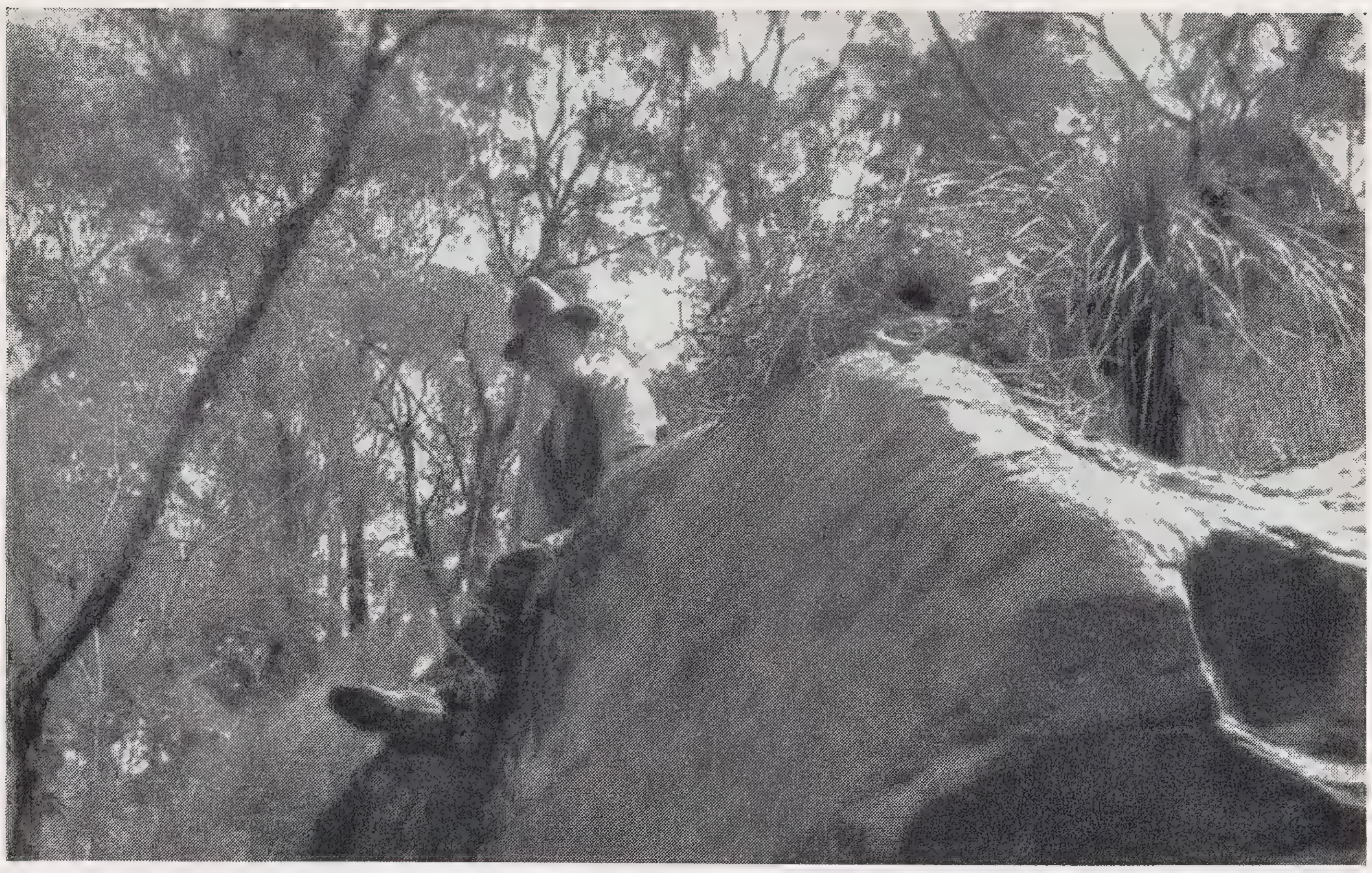
A few minutes earlier on the sunlit ridge, all was sunshine and warmth, but in the depth of the gully all was damp and darkened by the growth of dense foliage. Elk-horns grew on the butts of the large trees, many kinds of ferns, rock-lilies and orchids clung to the rocks on the hillside, and tangled masses of wire-like vines made our progress slow and tedious. Tripping and stumbling over rotten logs and branches, we at last reached the main creek and crossed the rushing torrent; the vegetation was less dense here and the ground showed many traces where a bird had been scratching. A little further on the soft, rich soil had been torn up in a surprising manner; alongside every rotting log and around the base of every boulder deep furrows had been made by the bird's powerful claws. The amount of energy expended in its search for food must be enormous, for the Lyre-bird in its wild state is essentially an insect feeder. On the hillside nearby an area of several acres had been literally ploughed up; it was almost beyond belief that this could be the work of a single bird, but such was the case. These restricted feeding-grounds are always a sure indication that a nest is close by, another sign being the presence of the Yellow-throated Wren which follows in the wake of the female Lyre-bird so as to feed on the smaller insects disturbed by the larger bird.

In this neighborhood, then, we began an intensive search for the nest. A small cave with a ledge or shelf is often chosen as a nesting site, but we found no caves, and knew, consequently, that the nest might be almost anywhere. This apparent indifference to a nesting site is a chief factor in the Lyre-bird's threatened extermination. The nest may be perched on top of a small boulder, with no attempt at camouflage, on the ground, or in the tall bracken on the sloping hillsides. Occasionally a nest is seen in the forks of a giant gum tree, many feet from the ground, a habit which now seems to have become more generally adopted.

The shadows were beginning to lengthen and a damp and chilly breeze stirred the air as our unsuccessful search went on. Realizing the difficulty of climbing out of the gully, we decided to lose no time in making the ascent and to renew our search next day. But at that moment a dark object glided down the hillside and dropped almost into the bed of the creek some distance ahead. Usually there is only one apparent reason for a sustained flight of such a distance. We halted until the bird came again into view from a thick patch of bracken. It was a hen Lyre-bird, and we watched her leisurely progress up the hill, probably working her way back to a nest, industriously scratching as she went. Then, with a leap of at least six feet, scarcely spreading her wings, she bounded up to a shelf of rock and was lost to our view.

We hurried down to search the little pools and potholes in the rocky bed of the creek to discover if what we surmised was correct. It was. Precisely at the spot where the bird dropped into the creek, we came upon a small, drying pool, nearly full of globules about the size of marbles. These we knew to be the excreta of a young Lyre-bird. Nearby another pool contained much larger globules, quite the size of golf balls. These were much distended by an albumen-like coating around them, swollen by their immersion in the water. Why, we wondered, does the Lyre-bird display such intelligence in the disposal of these globules according to the age of the young bird in correspondingly-sized pools which are eventually scoured out by the first downpour of rain, after which the same pools are again used? This precaution against discovery by prowling enemies would seem at variance with the bird's apparent indifference to a protected nest, but it may be that the latter is simply a result of their having not yet adapted themselves to present-day conditions. Before the introduction of the Fox and feral Cat they had but one nest-time enemy, the Tiger or Native Cat, for birds' greatest enemies, snakes and iguanas, at this time of the year are still hibernating, and the Dingo prefers the open country in which to run his quarry down.

Elated as we were at our discovery, which proved that we were on the right track, it was now too late in the day to search for the nest so we lost no time in climbing to the top of the ridge. It was on our journey down the gully next morning that we were fortunate enough to secure several pictures of a Lyre-bird on his dancing mound. So engrossed in his display was this particular bird in his noisy mimicry of a mob of Crimson Lories and Gill-birds that we managed a number of shots before he depressed his plumes, looked around and discovered our presence. Then the bird slowly moved away, scratching a little here and there, still singing the songs of many birds, punctuated with the unmistakable "honk-honk" of a motor horn—rather a startling sound in such sur-



The Lyre-bird cannot long stand exposure to excessive heat or sunlight, but it is not unusual to find nests in very exposed positions, as on the top of this rock. Since the bird is a winter breeder, the heat does not greatly affect the nest.

roundings! Probably the bird's tameness may be accounted for by the fact that a road was only a mile distant.

Starting from the creek we followed fresh scratches which become more abundant as we climbed the side of the hill. Every ledge of the cliff we explored for caves and at last our efforts were rewarded. Under an overhanging cliff, on a little shelf that seemed made for the purpose, rested a well-formed nest, containing a young bird about three weeks old.

Whatever these birds lack in defensive weapons is compensated by lung power. The instant we touched the nest, the young bird fell back and aimed left and right blows with its huge feet, meantime uttering the most piercing screams. In the midst of this uproar the old bird sailed down from the hillside and lobbed almost on our heads as she alighted near our feet and started vigorous scratching, filling her beak with insects. She refused to be driven away, and after taking a few snapshots we left the spot—much to the relief of the birds.

It was yet early in the day and, elated at our success, we continued down the hill past the small waterfall to the area where our futile search on the previous day took place. As we stepped from one stone to another to avoid the running water, we were blocked by quite a large pool. Here, to our amazement, perched on top of a great boulder in the middle of the waterway, was the nest for which we had searched in vain. We must have passed many times within a few yards of it.

Investigation of its contents was unnecessary, for before the nest was touched its inmate broadcast unearthly screams which re-echoed from the cliffs above. A swift, gliding form moved through the fern on the bank of the creek and next moment, with one bound, the mother bird, her beak crammed with insects, landed on top of the nest. After making a closer investigation of the nest the old bird casually hopped back to the bank and started her vigorous scratching, so characteristic of these birds when their young are in danger.

We found that the chick was just about the same age as the one we had left only an hour earlier. As a matter of fact, only on rare occasions is there any great variation in the age of the chick in any nest, for nidification is usually complete by the first week in September, or even earlier date if the nest is on or near the ground. We took a photograph of this nest in such an unusual position, and proceeded down the creek for about a mile, to a point opposite the precipitous cliff that had blocked our progress on the previous day. On the sloping heights above we searched for scratchings, and quite by accident came upon a most beautifully constructed nest. It might easily have been stepped upon had we approached it from any other angle. We did not expect, as we approached this nest, to hear that strident outburst from within, knowing full well that in such a position there was little likelihood of finding anything alive there. However, a greater surprise awaited us. Embedded in feathers was an egg which was quite cold, as indeed the eggs usually are during the daytime. To find an egg still in a state of incubation, for the shell was just cracking, was just one of those rare occasions which prove the exception to the rule.

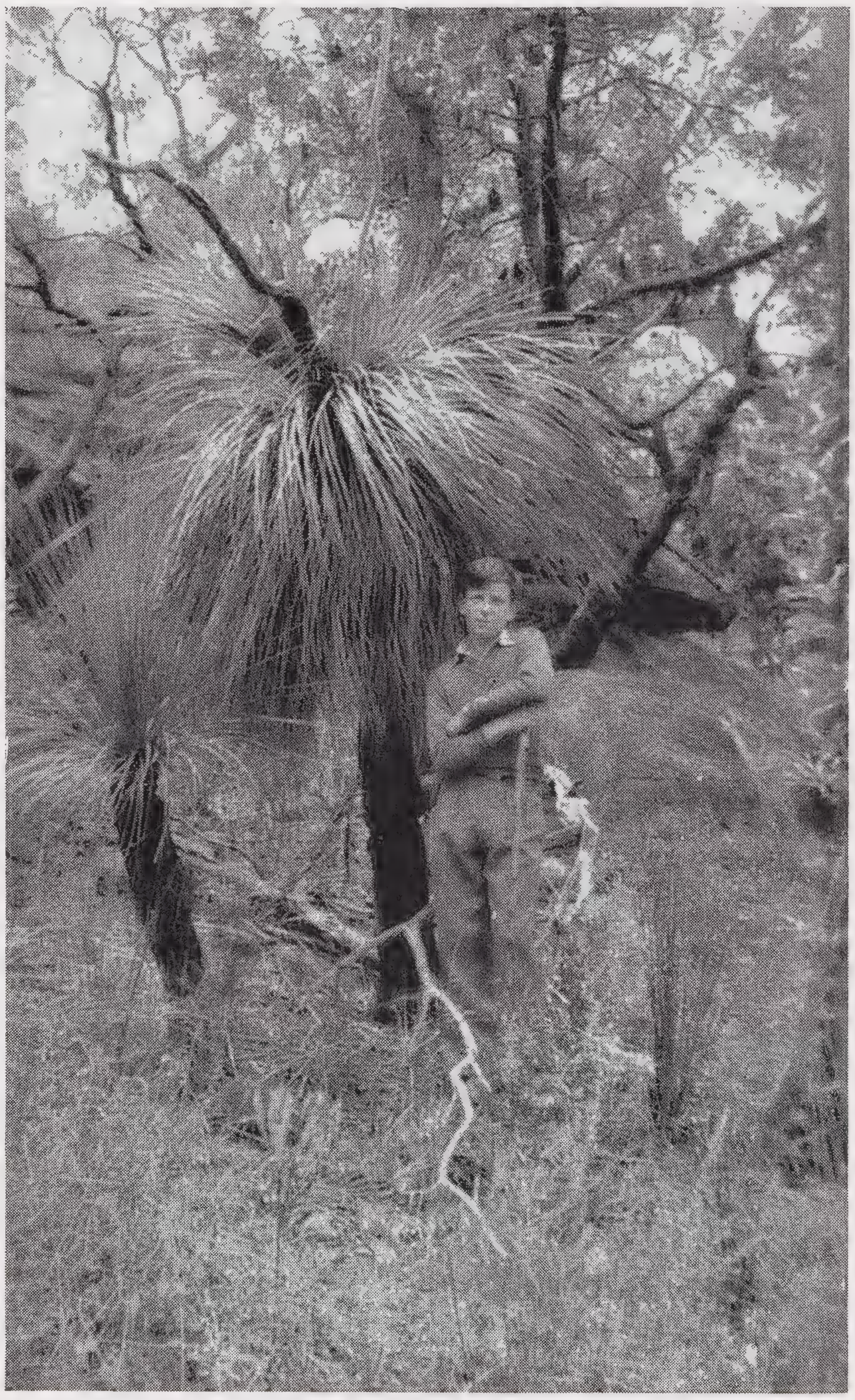
Incidentally, the foregoing warrants some explanation. As is generally known, the male Lyre-bird takes no interest whatever in family matters. When not feeding he spends most of the time in song and dance, seemingly in rapturous delight in the very joy of living. So the whole responsibility of nest-building, incubation, and the rearing of the chick falls upon the hen bird. After the nest is completed one egg is laid on its bare floor, which is composed of root fibre matted with soil. The egg possesses marvellous viability, for the bird is seldom on the nest during the daytime and this fact undoubtedly causes the development of the embryo to be greatly retarded. There are authentic records of the chick making its appearance in thirty-five days. Other eggs, however, have taken fifty days to hatch out. Probably the exact period of incubation cannot be determined until the egg of the Lyre-bird has been artificially incubated and hatched out, free from any unnecessary retardation.

It should not be surprising to one familiar with the life history of the bird that Nature has endowed the egg with productivity under such adverse circumstances, remembering that the hen bird has to rely entirely on her own resources for food. She has to forage for many hours, which takes her quite a distance from the nest. Indeed, often from early morning until late afternoon she is absent from the nest, for it is well known that she will not feed in the immediate vicinity of the nest.

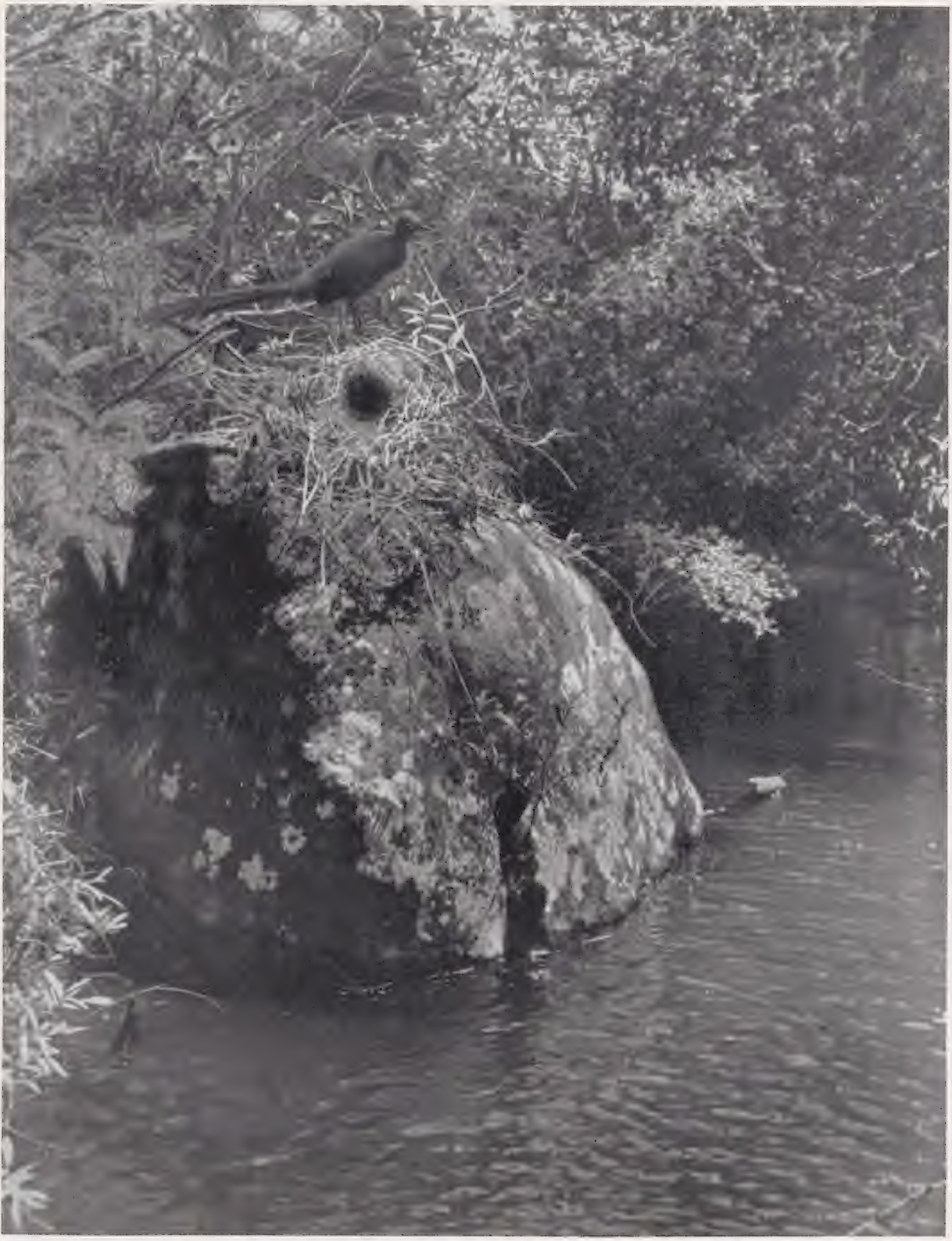
A few days prior to the hatching out, the old bird begins to make provisions for the comfort of the expected chick, by plucking each day a few feathers from her breast. With these the nest is well lined. When the tiny, soot-black chick appears, the egg-shell is carried out and eaten, as also are any loose feathers that may be detached from the nest.

As we were leaving the nest we noticed a hen Lyre-bird working her way towards it. We knew that she was watching us from her peculiar actions, which were characteristic of these birds just before or immediately after the hatching out of a chick. Vigorously shaking her tail from side to side she would take two or three steps, give the earth a couple of scratches—merely in pretence—as if searching for food. Then, shaking her tail once more, she would look up and proceed to repeat these actions again and again as she meandered around, awaiting our departure.

Two weeks later we set out in great hope of collecting the young birds from the nest. Our fears for the result of our quest, however, we optimistically failed to express, being only too conscious that a score of accidents could have befallen them during our fortnight's absence. But we were heartened at the feeding ground, for the scratching was fresh and extensive. The nest had rather a dilapidated appearance since last we had seen it; the top of the structure was completely pushed off and displaced to each



This is a grass tree, a type of vegetation whose decaying trunk provides plenty of fat young wood grubs for baby Lyre-birds.



Many times the nest-hunting party passed within a few yards of this exposed nest, and came upon it by accident just before the female hopped out of the ferns on the bank, her mouth crammed with insects for the hungry baby who was broadcasting unearthly screams.

side. This, we knew, was the result of the young bird continually stretching itself on its powerful legs and feet, eventually forcing away the top of the nest with its shoulders. No sign, however, of the young bird could be seen. To lie concealed is its only safeguard, even after it has left the nest, and it takes to cover in any dark recess except when abroad with the mother bird, learning to scratch. Even then, at the slightest sign of danger, it rushes to the nearest cover and crouches there until nearly stepped upon, when, with its ear-splitting scream, it will stagger along on its long legs and feet in a most ungainly manner.

To see if the nest was occupied we pushed a stick into it and the young one came plunging out on top of us, with the usual loud protests, using both legs and wings in its effort to escape. It was quickly joined by the old bird, which ran around us in a state of great excitement, uttering the while a plaintive little cry. The youngster was caught and placed in a bag, where it soon became reconciled.

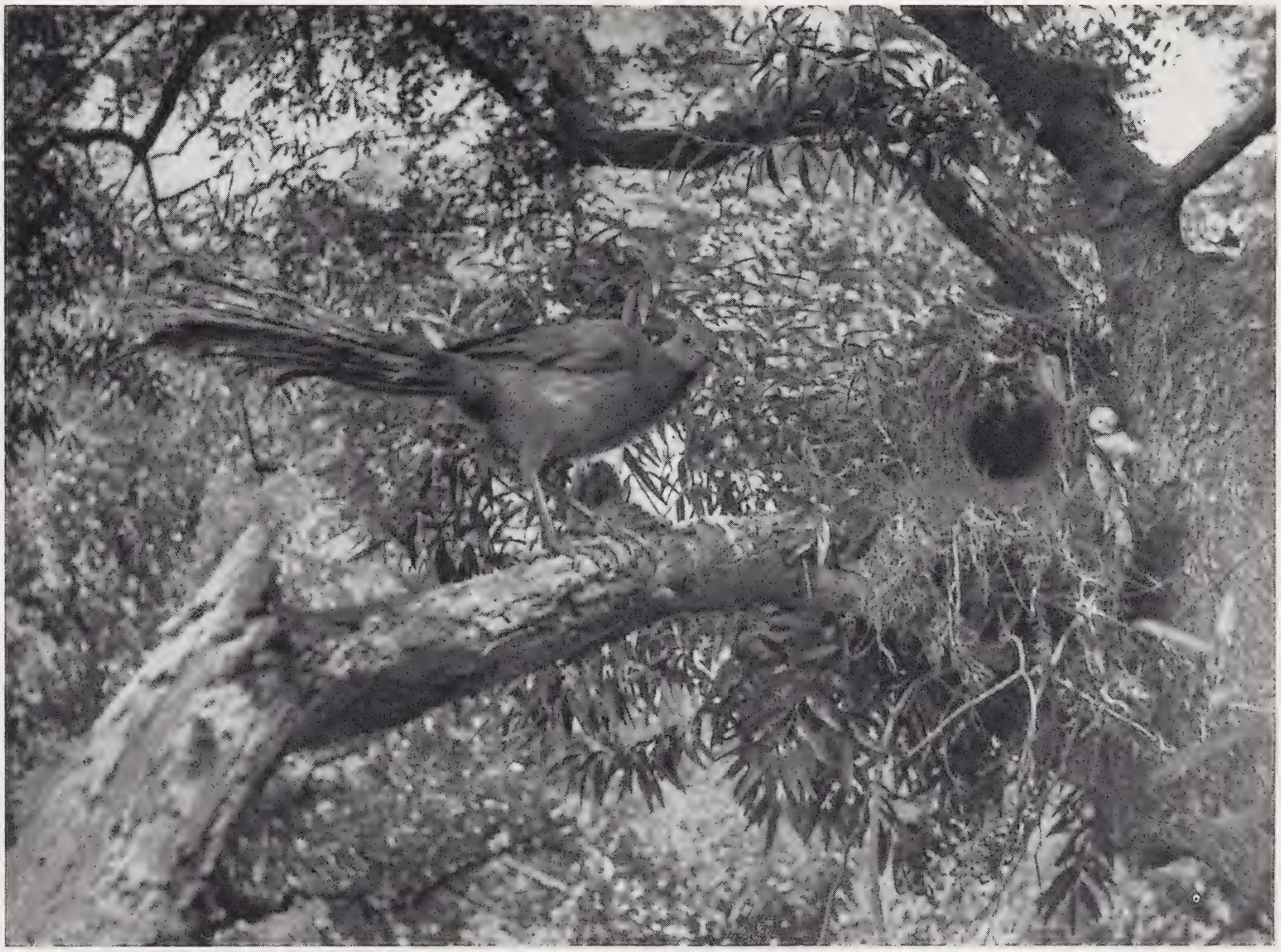
Half an hour later we reached the main creek and scrambled over the rocks to the other side, feeling sure of securing another young bird from that well-protected nest in the creek. Some distance from the nest we examined the ground where previously the old bird had shown great activity, but now scarcely a trace could be found. Even had the chick left the nest and survived, pronounced evidence of its presence would be found in the immediate vicinity, for the birds never leave these feeding grounds until they are separated.

When we pushed through the thick scrub to the water's edge, from where we could see the nest, it showed no trace of molestation but had seemingly been empty for some time, for the top portion was still intact. Not the slightest evidence of what had happened to this nest could be seen—the young one had simply disappeared. To add to our disappointment a drizzling rain commenced to fall; wet and cold, we climbed to the first ledge of rocks, determined to visit the nest which was further downstream. It was unlikely that we would find a young bird in this nest, for again, as we approached, the scratching of the bird was conspicuous by its absence. The nest was empty, and a few dry blood spots on the ground, along with a few pin-feathers, spoke only too plainly of what had happened.

Rain was falling steadily as we crossed the main creek and made our way up through the sodden grass and fern, to spell for a moment in the shelter of a shelving rock and gaze at the depressing outlook across the gully. The steady drip-drip of the raindrops from the countless leaves alone broke the eerie silence of the jungle. Then the downpour stopped as suddenly as it began, and the glistening foliage was bathed again in sunlit glory. High overhead came five great black Cockatoos, each trying to out-scream the other, as though angrily driving the racing storm clouds before them.

There was little climbing to be done to reach the next nest in a small cave in a fertile valley. Here again the absence of scratching spelt disaster, for the nest proved to be empty with every indication that the chick had been well-developed before it had left the nest. On the sandy floor of the cave were many pad marks of a Fox, along with the impressions of the old Lyre-birds' feet. Obviously the Fox had starved out the young bird by its persistent waiting near the nest. One can visualise the anxious moments of the mother bird, her mouth crammed with food, striving to reach her hungry chick and at the same time guarding her own safety. Mad with hunger, the chick comes tumbling from the nest to meet her, only to be devoured soon afterward—just another tragedy of the bush!

Crossing this shallow gully which was little more than a depression, we made good progress down to the spur that juts out into the Hawkesbury River itself, where a nest was placed in a position somewhat similar to the one we had just left. Our fears for the safety of the young bird were increased as we drew near the nesting place, for the sand underfoot was well marked with Fox pads. It was a pleasant surprise as we reached into the nest to hear the nerve-racking screech of a young bird. It was a miserably poor and fly-blown creature. The nest was much fouled by the young bird's excreta, which had not been removed by the mother in her hurried feeding trips. Often her visits must have been interrupted by the lurking Fox, and the old Lyre-bird could not under the circumstances keep up a regular food sup-



If this Lyre-bird sought protection for her nest by building it in a tree, she chose an exceedingly poor location, for the dead limb that gave her a convenient landing place and perch, also provided a perfect means of access to marauding cats, one of the bird's chief enemies.

ply. Soon the youngster, becoming more desperate every day, like many another, would flop to the ground, with the inevitable result. We had rescued it just in time.

Our first thought was to provide a substantial feed for the half-starved bird. By knocking over a dead grass-tree and smashing away the thick bark, we collected from the rotting core quite a number of fat wood-grubs, and pushed these down the bird's gullet every time it opened its beak to squawk. On our way back to the car we collected many more grubs from the dead grass-trees, of which there was an abundance, owing to the bushfires having killed them probably more than a year before. Our attempt to feed the bird that we had secured earlier in the day brought forth such a hullabulloo that we quickly replaced it in the car and made our way homeward.

On what remained of the grubs the birds were fed night and morning for the next few days, their food during the daytime being somewhat varied. In a few days they were quite reconciled to their new surroundings and would greet any advance with a purring little chirp, gaping readily when food was offered them. Although they were more than five weeks old, these young birds needed constant attention and if left unfed for any length of time would soon remind us by their shrill whistle. It was somewhat of a problem to supply suitable food for these hungry and fast-growing chicks, for their capacity for assimilating worms, grubs and hard-boiled eggs was enormous. When worms were not available, carefully-scraped beef pulp was given as a substitute. Any fibrous or insoluble matter in their food before they are able to scratch and run about to digest what they have eaten, will remain in the crop, where it accumulates into a hard, dry mass, and bring about their death in a few days. They are unable to disgorge those casts of refuse that are so easily disposed of by most insectivorous birds. Cereals of any kind or in any form must be avoided while the birds are so young, but when they are matured and able to fend for themselves they become practically omnivorous, whole grain being the one exception.

I stated earlier that certain descriptions quoted by many writers concerning the life and habits of the Lyre-bird are erroneous and not authentic. Some of these misleading statements have been and still are responsible for the idea that the male bird sings and disports its plumes in the shape of a lyre. This is not so, notwithstanding the fact that the bird is able to raise or depress to a degree any one set of plumes at will. It is a physical and mechanical impossibility to erect and carry its lyre-shaped plumes in an upright position. The tail feathers, when being displayed, are spread fanwise, the main plumes gradually taking a more or less horizontal position. It seems a pity to explode the popular idea of the lyre-shaped tail but when one has witnessed the gorgeous display given by a live bird there are no regrets that it does not follow the mythical pattern.

One writer states: "With an audience of one or more hens, the male lyre-bird mounts a low pile of earth, spreads his glorious lyre-shaped tail, dances and goes through an amazing repertoire of song and impersonation evidently for the bird's entertainment." This much-quoted mis-statement of the male bird displaying to an audience of hen birds is persistent and a favorite with many writers, not only with regard to the Lyre-bird, but also to the Bower birds and the Birds of Paradise. Emphatically such is not the case. The hen birds are quite indifferent to the cock birds' manoeuvres on the mound and never congregate to watch the amorous gestures. I have often wondered why some writers on the Lyre-bird are so reluctant to admit that the display mound is a dancing mound. Some state that they are not and never were dancing mounds, but fail to state what they actually are, discreetly avoiding the point by stating that the bird will sing and dance anywhere. This is quite so, but on the other hand the bird never visits the mound other than for the purpose of displaying its wonderful plumes in glorious rhythm and song.

What are we going to do about these wonderful birds? A few years hence the Lyre-bird will be in the same category as our now jealously-guarded Koala, and if immediate action is not taken for its preservation it will soon become extinct. If that happens, one of Nature's most marvellous achievements in avian life will have been lost for ever.

A young Lyre-bird—more than two months old, and still quite a baby.

What We Know About the Electric Eel

A Long Series of Investigations at the New York Aquarium Is Disclosing Some Amazing Facts about the Fish

Christopher W. Coates

THE demonstration of electric eels and their electrical powers in the Zoological Society's building at the New York World's Fair is the first really substantial popular exhibition of these curious animals ever made, and it has given rise to more questions about the fish than I thought could possibly exist.

Although all of the recent scientific research on electric eels has been done in the laboratories of the New York Aquarium, and all the various electrical computations have been made by the staff or associates of the Aquarium, we ourselves are still astounded by the electrical power of the fish, and check and cross-check with other departments of science before we feel we can make any kind of assertion. For this reason we are not surprised when people question our statements, nor do we feel unduly put-out when they doubt them. After all, it is somewhat in the nature of a fish story to say that a fish four feet long and about five or six inches in diameter has a power pick-up several times that of an ordinary automobile—and yet that is just what this electric eel has! To reduce it to figures, any average electric eel of three feet or longer has a power pick-up of about 150 horsepower per second, a fact which seems to belong in the "Believe It Or Not" class. Our demonstrators at the Fair are instructed not to make this statement because it is sure to be challenged, and the calculations necessary to prove it are too complex and lengthy for the time and place. Nevertheless, it is quite true.

Why it would be necessary to prove it by calculation and not by taking the eel out and having it run two or three cars at once is the stumbling block in all popular demonstrations of this fish. The point is that while the fish has this power and releases it whenever it wishes (or, in the case of those at the Fair, whenever they are tickled), the speed with which it is released is so fast that the ordinary available kind of machinery is quite unable to respond before the impulse is gone. This can be explained most simply by the example of ordinary incandescent electric lamps.

In this part of the world, the electric current supplied for household use is 110 volts, and a standard electric lamp is, say, 60 watts. We have drawn from an electric eel almost 600 volts and about 1,000 watts, which is obviously enough to light a great many of these standard electric light bulbs. However, the eel cannot light any of them because the inertia of an ordinary electric lamp takes about one-fiftieth of a second to overcome, while the discharge of the electric eel, although it is so much greater than that required to light the lamps, is passed and gone in about two one-thousandths of a second, or in about one-tenth of the time it takes the lamp to light. If the lamp, by any accident, ever did light, the filament would be burned out instantly.

In terms of power machinery, a one horsepower motor, attached to a 110 volt line, would draw about 750 watts of current. This is not nearly as much as the eel can deliver, but here again the speed of the discharge is so fast that the motor would not begin to turn before the discharge had passed.

It is this terrific speed of the propagation of the pulse which makes the electric power of the fish so difficult to demonstrate and so difficult to understand.

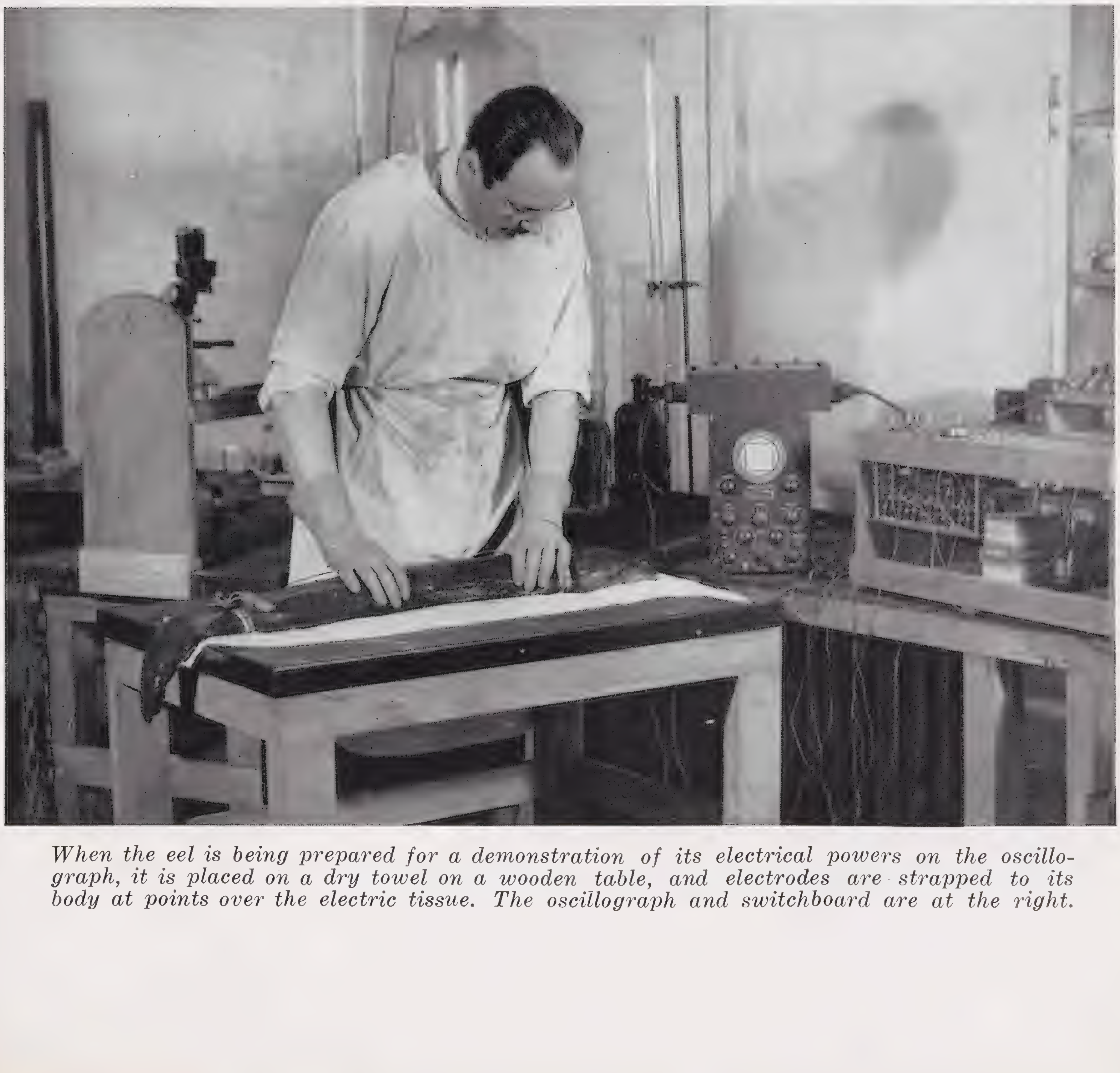
It is, in fact, the cause of the long delay in finding out anything whatever about the fish's electricity, in spite of considerable effort on the part of such investigators as Faraday and Cavendish, both of whom made several conjectures about it which they were unable to confirm.

At the beginning of my investigation of this strange manifestation of nature all that was definitely known about the discharge of the electric eel was that it was powerful enough to knock over, and perhaps kill, a horse; that the fish could discharge a current at will; and that it was dangerous to touch or annoy an electric eel. There had been a number of theories and conjectures. Estimates of the voltage ranged from 35 to 600, and speed of discharge from one ten-thousandth of a second to one-tenth of a second.

Although I had a fairly thorough knowledge of electricity, plus a determination to find out how the eel "worked," for a long time I was unable to devise any kind of an electrical circuit that could be activated by the fish and show a demonstrable result. One after another I set up electrical measuring devices, some of them costly and elaborate, and one after another the powerful current burnt them out and ruined them.

Then, after four years of experimenting, there came a Saturday afternoon that was the real starting point of our subsequent investigations. The Aquarium's laboratory was a maze and tangle of wires. The eel that was the subject of the experiment had been behaving badly, and the floor was liberally splashed with water. So many experiments had gone wrong, and so many wires were literally at loose ends, that it was no wonder that I was tired and confused.

Suddenly I got a terrific shock—and at the same instant a neon tube on the laboratory table burst into a dull orange glow! The shock was so bad that for a moment I wondered if I really had seen the tube light up, or whether it was an effect of the shock on my own system. But a chance visitor in the laboratory had seen the same thing, without feeling the shock. Here,



When the eel is being prepared for a demonstration of its electrical powers on the oscillograph, it is placed on a dry towel on a wooden table, and electrodes are strapped to its body at points over the electric tissue. The oscillograph and switchboard are at the right.

at last, was the kind of a demonstration I had been seeking.

Carefully I traced the connections. One wire to the neon tube dangled in the eel's tank; another had "shorted" through my arm to the damp floor. I found that by hooking the tube to two wires, dropping their ends into the tank and tickling the eel until it discharged, I could make the tube glow any time I wanted it to—without the necessity of getting a shock!

That was real progress — I had an easily observable demonstration of the electricity—but actually it told me very little about the voltage and wattage of the eel's current, for the bulb I was using would operate on voltages all the way from 80 to 2,000, with very low wattage. I wanted a more accurate measurement than that.

After several more experiments, I had sufficient information to have the General Electric Company make a sort of voltmeter for me. This was necessary because the ordinary voltmeters would not work at all or were ruined, although I still did not know why.

This special voltmeter was made of a series of resistances and a battery of neon pips, so arranged that if the voltage discharged was less than one hundred, one pip would light, if between one hundred and one hundred and fifty, a second one would light, and so on. I used neon pips because these are practically instantaneous in action and have no inertia such as ordinary lamps have.

The results from observations made with this voltmeter were sufficiently interesting for me to approach the department of physics of one of our great universities and ask for advice and assistance, with the result that Dr. Richard T. Cox, professor of physics at University College of New York University, agreed to collaborate with the Aquarium in research on the discharge of the eel.

By means of the apparatus which then became available, and of special apparatus which we built, we were able to make exceedingly accurate measurements of voltage, power and speed of propagation.

The chief instrument we used, and still use, is the cathode ray oscillograph, which indicates by a tracing on a screen the impulses fed into it.

This may be photographed, using the proper photographic equipment, and the traces caused by the eel compared with those caused by electrical impulses of known value. This is a positive means of identifying the kind of electricity discharged by the fish.

The voltage varies with each individual, but eels which are a yard or so long seem to have reached their peak, which may be between 450 and 600 volts. The average eel seems to run about 550 volts. Eels smaller than this still have considerable amounts of electricity. One little fellow about nine and a half inches long, with a displacement of less than fifty cubic centimeters (the equivalent of only a few spoonsful of liquid) discharged 198 volts. After repeated discharges for several hours, it had run down to 135 volts. Eels more than three feet long—they reach a length of about eight feet—do not increase appreciably in voltage, but they have more power.

The average discharge of the fish in the fresh water in which it lives is about 40 watts, but as we said before, we can draw almost one thousand watts without disturbing the fish in the least. The eel can discharge more or less constantly without distress, but if it does discharge repeatedly without finding either food or enemies, it becomes conditioned and will not discharge any more. Some of them become so tame that they will follow their keeper about, as far as the confines of their tank allow.

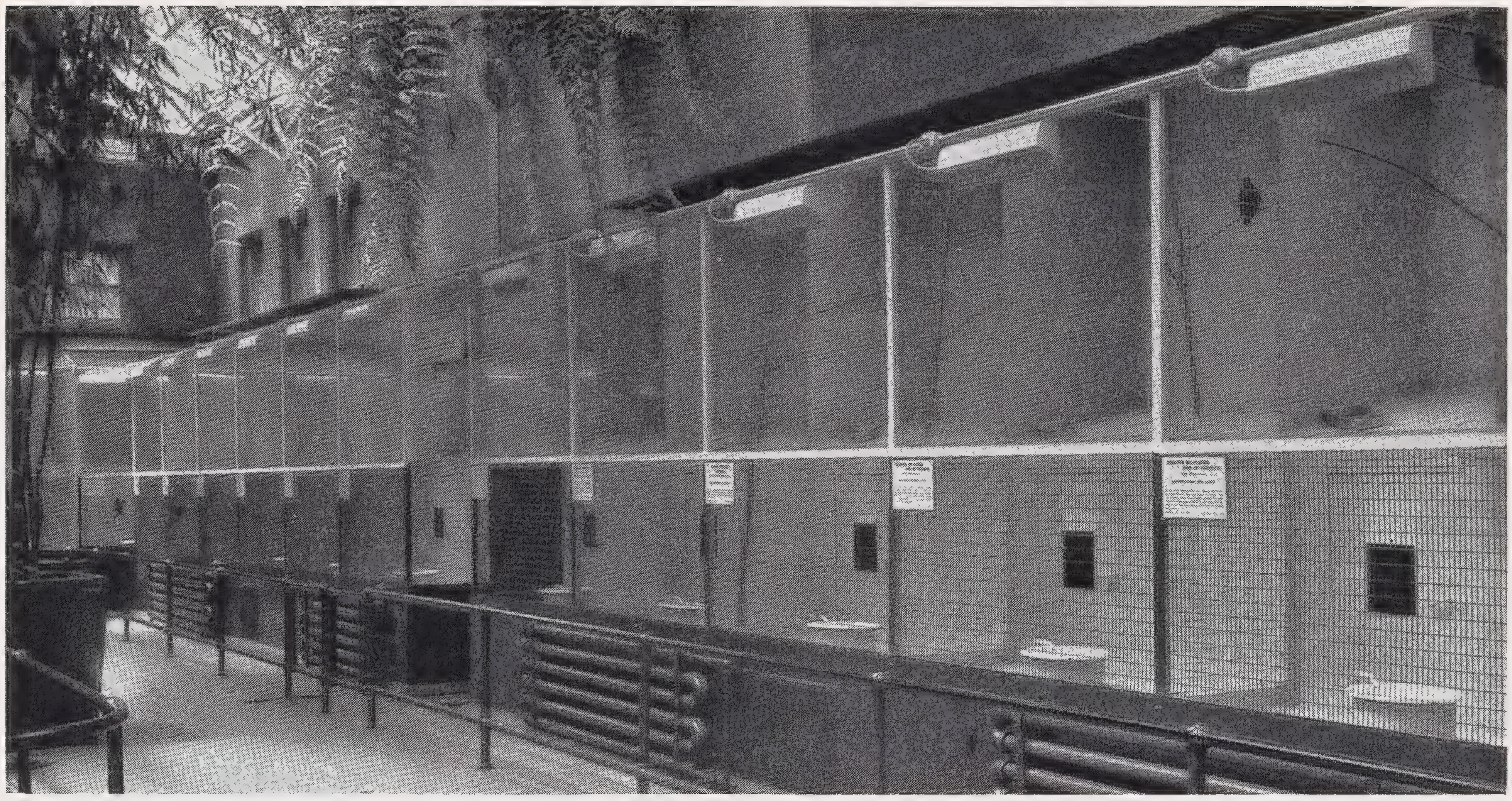
The speed of the propagation of the pulse along the body is amazing, and caused us a good deal of trouble in checking before we could accept it. The discharge is roughly comparable, in nature, to that of a nerve in one's body, greatly enlarged, of course, and the speed of a pulse along a nerve fiber is much less than one hundred meters a second. However, the speed of the pulse along the body of an eel is considerably faster than this. We have records of about fifteen hundred meters a second, but most of our measurements show it to be between five hundred and twelve hundred a second.

The electric eel is a true fish, although it is not properly an eel. The popular name comes from the shape of its body and its electric powers. It lives in the fresh waters of most of tropical South America and although it is fairly abundant where it is found, it seems to be pretty well localized. No one has reported any information whatever about its breeding habits.

The temperature of the water in which it lives must be kept close to 80 degrees Fahrenheit, and although the fish seems to do well in our tanks, and individuals have been hauled up and down the country for demonstrations without any ill-effects, other people report it as being difficult to keep alive. Its diet in nature consists entirely of other fishes, but in the Aquarium it does very nicely on a diet of raw beef heart fed three times a week.

The electricity arises from three pairs of electric organs which make up about two-thirds of the tail. This, however, is a true but deceptive statement, for the tail is almost five-sixths of the total body length, so that about one-half of the fish is electric tissue. This is a special kind of tissue which is modified muscle, and is composed of millions of tiny electric cells hooked up in a serio-parallel connection. When the eel discharges, which it can do about two or three hundred times a second, it actually throws on, each time, millions of switches to connect all these batteries, a feat which no human electrician has yet accomplished in so short a time.

Electric eels have parasites on their skin—tiny creatures which apparently are not affected by the discharge of the powerful current. Here, their hands protected by heavy rubber gloves, Mr. Coates and Dr. Nigrelli are removing parasites for laboratory examination.



Looking down the glass-fronted cages housing the Birds of Paradise.

The Bird House in New Plumage

Starting with a New Glass Roof, a Whole Train of Improvements Followed to Increase the Pleasure of Visitors

Lee S. Crandall

IN all the thirty-three years of its history the Bird House has not had such a "doing over" as it underwent during the past winter. Officially it was "unveiled" at the Members' Day party on May 18, but actually we have been unveiling it step by step since last fall when roofers began to remove the effects of time and grime.

The changes really are few in number, but significant and effective. The original glass roof has been replaced by a smaller area of glass of a more efficient corrugated type. All the cages in the Main Hall, housing the Birds of Paradise, Toucans and Hornbills, have been half-fronted with plate glass. A Hummingbird Cage was built at the west end of the Main Hall Flying Cage, and printed picture labels are replacing all of the old hand-lettered labels.

In its main features—size and location of cages, convenience of handling the collection—the building has always been generally satisfactory and we have had little reason to envy the housing of bird collections in other zoological gardens either in this country or abroad. More room, of course, we wanted—and still want. The size and variety of the collection will always be limited arbitrarily by the available cages. The renovation of the past few months will perhaps have little effect upon the well-being of the collection, but it certainly will increase the public's pleasure and instruction.

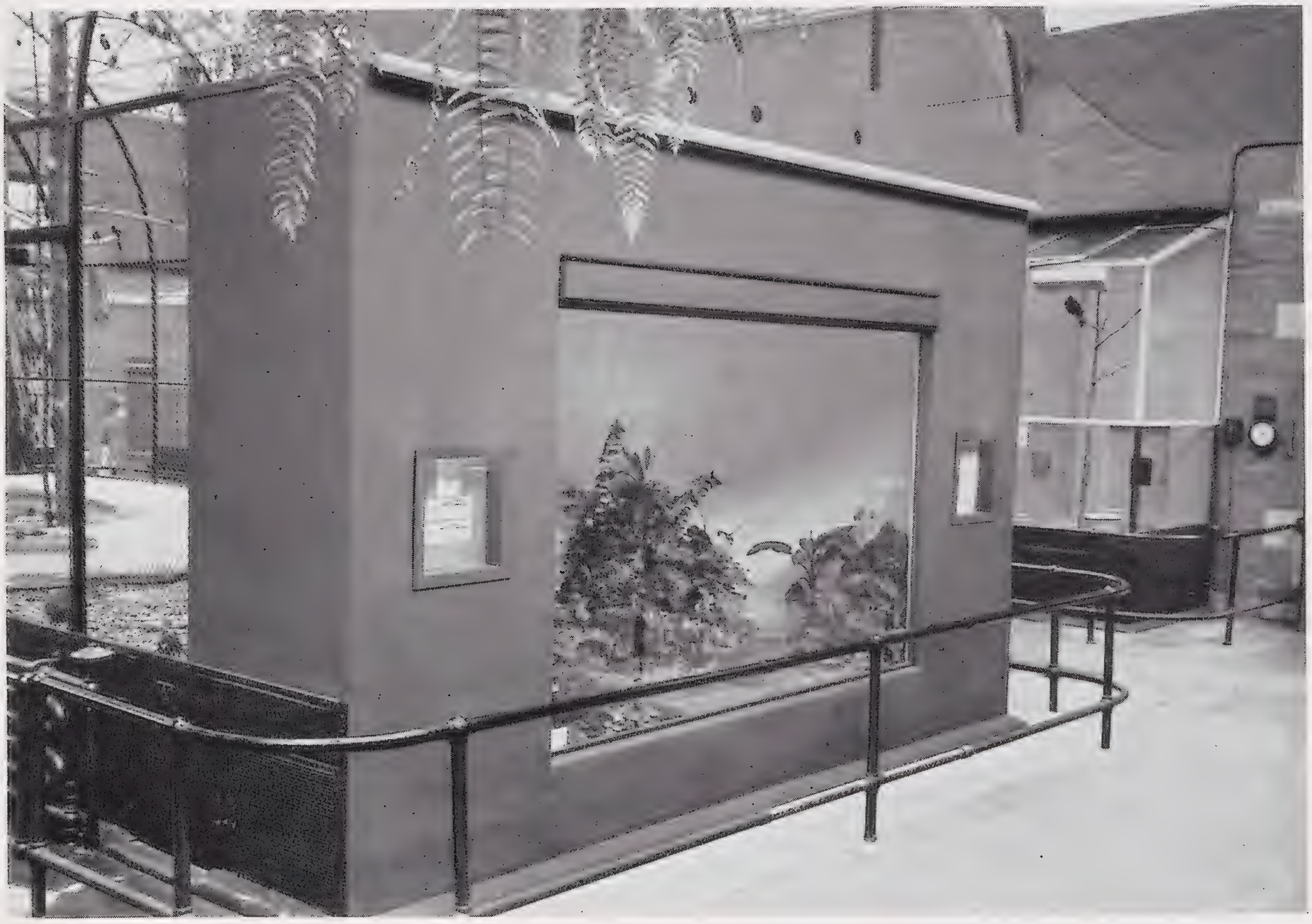
It was not without misgivings that we watched the arrival of the roofers on a chilly day last October. Bitter winter weather was only a few weeks away, and we were proposing to unroof a building housing hundreds of tropical birds. In practice, it turned out to be less difficult and dangerous than it sounded. Before any small section of the old glass roof was removed, a temporary roof of boards and heavy paper was constructed under the old one, and the less hardy birds were caught up and removed to other halls where the roofers were not yet working.

Strangely enough, the birds paid little attention to the shifting, hammering and confusion of the next few months. Until the end of the winter losses were no more than normal, and they increased only slightly near the end of the modernising process when painters, glass-setters and carpenters swarmed through the interior of the building and shifting from one cage to another was almost an hourly routine.

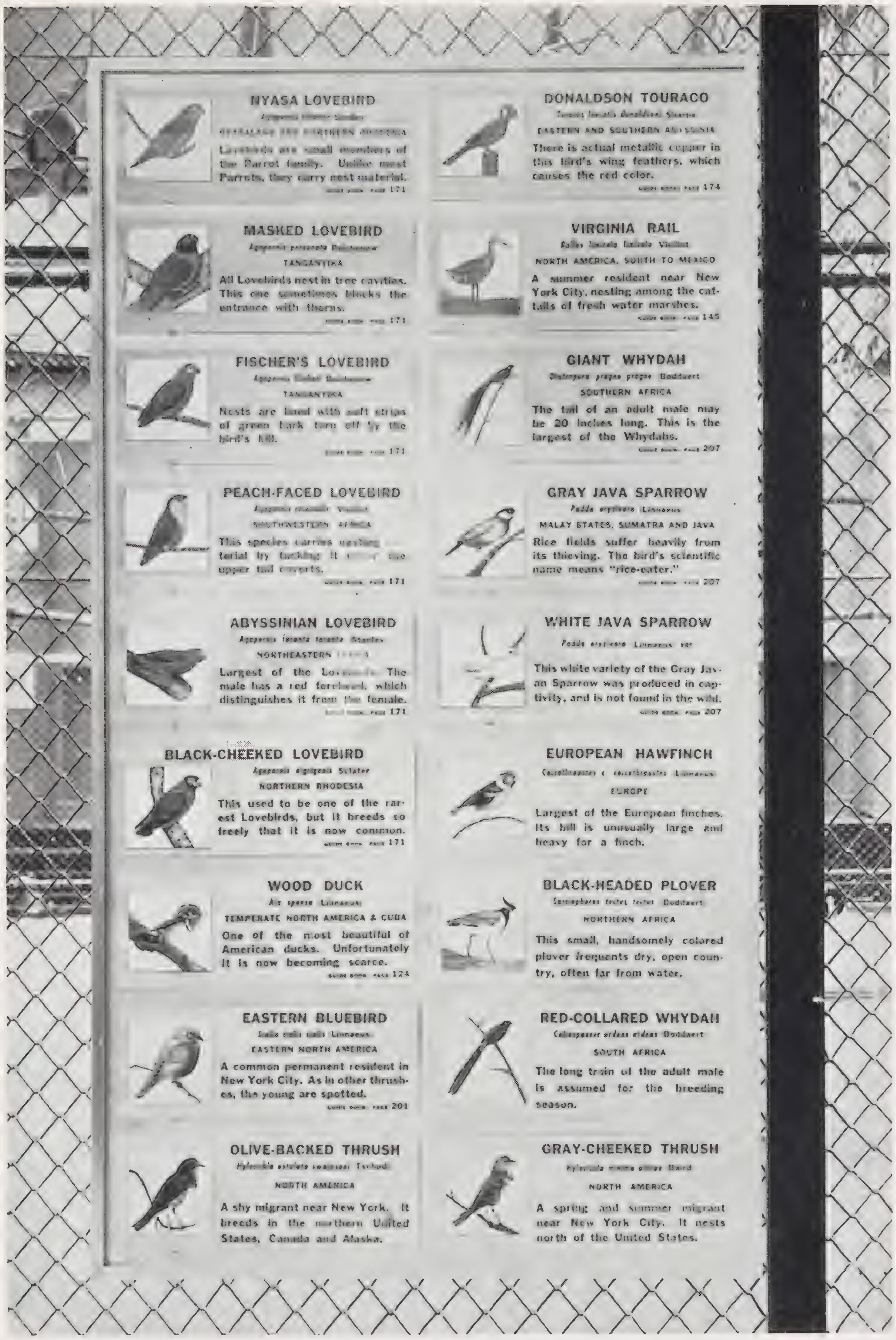
As the Bird House was originally constructed, approximately 10,000 square feet of its roof was flat glass. Under the specifications by which the City replaced the roof, a more efficient light-diffusing type of corrugated glass was used and the glassed area was reduced to about 2,400 square feet—with an astonishing increase of soft, diffused light throughout the building.

About three years ago a single cage in the Bird of Paradise row in the Main Hall was fitted out with a plate glass front to enable the photographer to take the remarkable series of display pictures subsequently reproduced in the *Bulletin*. The visibility of that single cage was so greatly increased that it was decided to seize this opportunity of glassing the fronts of all the Main Hall cages. The top and the lower third of the front remain wire, to take care of ventilation. For the first time our Main Hall birds are perfectly and easily visible, and their voices are by no means muted by the glass—not that any of those particular birds are noted for their songs!

About the new Hummingbird Cage we hope to say more in a later issue of the *Bulletin* when we have had more time to observe it in operation. Hummers we have kept sporadically for years, but always in small cages that gave them no opportunity for real flight. Now they have room to make their zooming darts, a lovely background of rock and permanent green planting and a fountain and shallow pool in which to bathe. The cage was, frankly, an experiment; there seemed to be no reason why it would not make a satisfactory home for Hummers, but such birds are delicate and temperamental and we could only build, install and hope for the best.



The new garden-cage for the Hummingbirds occupies the west end of the flying cage in the Bird House. The planting is permanent, and there is a fountain on the floor of the cage.



NYASA LOVEBIRD
[illegible]
[illegible] NORTHERN [illegible]
Lovebirds are small members of the Parrot family. Unlike most Parrots, they carry nest material.
GUIDE BOOK PAGE 171

MASKED LOVEBIRD
Agapornis personata Reichenow
TANGANYIKA
All Lovebirds nest in tree cavities. This one sometimes blocks the entrance with thorns.
GUIDE BOOK PAGE 171

FISCHER'S LOVEBIRD
[illegible]
TANGANYIKA
Nests are lined with soft strips of green bark torn off by the bird's bill.
GUIDE BOOK PAGE 171

PEACH-FACED LOVEBIRD
[illegible]
SOUTHWESTERN AFRICA
This species carries nesting material by tucking it [illegible] the upper tail coverts.
GUIDE BOOK PAGE 171

ABYSSINIAN LOVEBIRD
Agapornis taranta taranta Stanley
NORTHEASTERN [illegible]
Largest of the Lovebirds. The male has a red forehead, which distinguishes it from the female.
GUIDE BOOK PAGE 171

BLACK-CHEEKED LOVEBIRD
Agapornis nigrigenis Sclater
NORTHERN RHODESIA
This used to be one of the rarest Lovebirds, but it breeds so freely that it is now common.
GUIDE BOOK PAGE 171

WOOD DUCK
Aix sponsa Linnaeus
TEMPERATE NORTH AMERICA & CUBA
One of the most beautiful of American ducks. Unfortunately it is now becoming scarce.
GUIDE BOOK PAGE 124

EASTERN BLUEBIRD
Sialia sialis sialis Linnaeus
EASTERN NORTH AMERICA
A common permanent resident in New York City. As in other thrushes, the young are spotted.
GUIDE BOOK PAGE 201

OLIVE-BACKED THRUSH
[illegible]
NORTH AMERICA
A shy migrant near New York. It breeds in the northern United States, Canada and Alaska.

DONALDSON TOURACO
Turacus leucotis donaldsoni Sharpe
EASTERN AND SOUTHERN ABYSSINIA
There is actual metallic copper in this bird's wing feathers, which causes the red color.
GUIDE BOOK PAGE 174

VIRGINIA RAIL
Rallus limicola limicola Vieillot
NORTH AMERICA, SOUTH TO MEXICO
A summer resident near New York City, nesting among the cattails of fresh water marshes.
GUIDE BOOK PAGE 145

GIANT WHYDAH
Diatropura progne progne Boddaert
SOUTHERN AFRICA
The tail of an adult male may be 20 inches long. This is the largest of the Whydahs.
GUIDE BOOK PAGE 207

GRAY JAVA SPARROW
Padda oryzivora Linnaeus
MALAY STATES, SUMATRA AND JAVA
Rice fields suffer heavily from its thieving. The bird's scientific name means "rice-eater."
GUIDE BOOK PAGE 207

WHITE JAVA SPARROW
Padda oryzivora Linnaeus var.
This white variety of the Gray Javan Sparrow was produced in captivity, and is not found in the wild.
GUIDE BOOK PAGE 207

EUROPEAN HAWFINCH
Coccothraustes c. coccothraustes Linnaeus
EUROPE
Largest of the European finches. Its bill is unusually large and heavy for a finch.

BLACK-HEADED PLOVER
Sarciophorus tectus tectus Boddaert
NORTHERN AFRICA
This small, handsomely colored plover frequents dry, open country, often far from water.

RED-COLLARED WHYDAH
Coliuspasser ardens ardens Boddaert
SOUTH AFRICA
The long train of the adult male is assumed for the breeding season.

GRAY-CHEEKED THRUSH
[illegible] *Baird*
NORTH AMERICA
A spring and summer migrant near New York City. It nests north of the United States.

This is one panel of the new type of labels being installed throughout the Bird House. Each printed label, on light green cardboard, bears the common name, Latin name, habitat a sentence or two about the habits of the bird, usually a reference to the page on which additional material will be found in the Park's Guide Book, and a colored photograph of the species.

The birds, five specimens of two species, were liberated in the cage for the first time on the occasion of the "Spring Safari," and we discovered almost instantly that the installation was going to be a great success. We have had few exhibits in all these years that drew such instant and complete admiration from visitors. No little part of the attractiveness of the cage is the exquisite planting in the background which was arranged by Head Gardener George Skene.

The last item in our modernization is a new set of labels for the entire Bird House Collection. We have always taken pride in the informative side of our labelling; for a majority of our specimens the hand-lettered labels bore the common name, Latin name, habitat and a few sentences of interesting information. Often the label carried also a painted picture of the bird to make it easy for the visitor to identify the species among its cagemates. Of the battered and faded appearance that the signs acquired over the years and of their uncertain, often askew, attachment to the fronts of the cages, we were not so proud.

Most of those difficulties have been overcome by the adoption of cardboard labels printed from type. Previously we have never had labels for all species because the size of the label—8 x 5 inches—would have required too much space on the front of the cages holding large numbers of species. By the printing method, not only can we give several additional words of information, but the size of the label has been reduced to 9 x 3½ inches, with no loss in readability. Moreover, each card will bear a hand-colored photograph of the species. These pictures are two and one-half inches square.

The task of equipping the entire Bird House collection of more than 400 species with individual labels, each one bearing a colored photograph, is obviously a very large one and it may be some months yet before the job is finished. The printing is in the hands of Stephen Beebe, for many years the Park's sign painter, and despite a complete unfamiliarity with the printer's trade a few months ago, he took hold of it with such enthusiasm and willingness that the actual printing of the labels will soon be finished. The addition of the identifying pictures, which are being colored by Joel Stolper, is a more tedious task that will require longer to complete. Eventually all of the interior and most of the exterior painted cage-signs in the Park will be replaced by printed ones.

The Department of Tropical Research at the World's Fair

By a Variety of Exhibits It Presents the Unseen Life of New York City, Isolated in Time and Water

WILLIAM BEEBE

THE slogan and emphasis of the World's Fair is the Future. The fascination of the Future is probably its quality of mystery, of the unknown. When planning a suitable exhibit of the Department of Tropical Research in the building of the Zoological Society, it occurred to me that this element of mystery could be supplied not only in the Future, but in the Present and the Past as well, and close to the Fair and to New York City.

I chose Time and Water to emphasize these aspects of life on the earth. In Time I selected a million years ago, and am showing the creatures, now extinct, which lived in and near our city during the time of the coming and going of the glaciers; the Sabre-toothed Stabbing Tigers, giant Beavers and Ground Sloths, Forest Horses, Stag-Moose, Royal Bison, Walrus, Mammoths and Mastodons. Evidence from fossil bones and teeth is conclusive that these and other even stranger animals roamed over Long Island, the Palisades, New Jersey beaches, eastern Pennsylvania and the neighboring parts of Connecticut. All lived within a one hundred mile circle of the Zoological Park in the Bronx, where at present we are studying the living creatures of the earth.

Under the second symbol of Water, I class the little known dragon-like beings which inhabit the great Hudson Gorge,—a Gorge which forms the water-covered lower end of the Hudson River. Out and out it extends, beneath calm and storm, with the keels of thousands of vessels passing overhead. Only our sounding apparatus shows its position and enormous cragged walls, and only our inadequate nets and dredges bring us knowledge of the weird creatures which inhabit it today.

Half a mile to a mile down there is no light, only bitter cold and a pressure beyond conception. Here lives the great underworld of the sea, submarine gangdom whose great fangs and enormous mouths are ever turned upon their neighbors. In that world, within one hundred miles of our city, and Zoological Park and World's Fair, there is no vegetation, no creatures which rely upon it. They must depend for food upon other animals, living or dead.

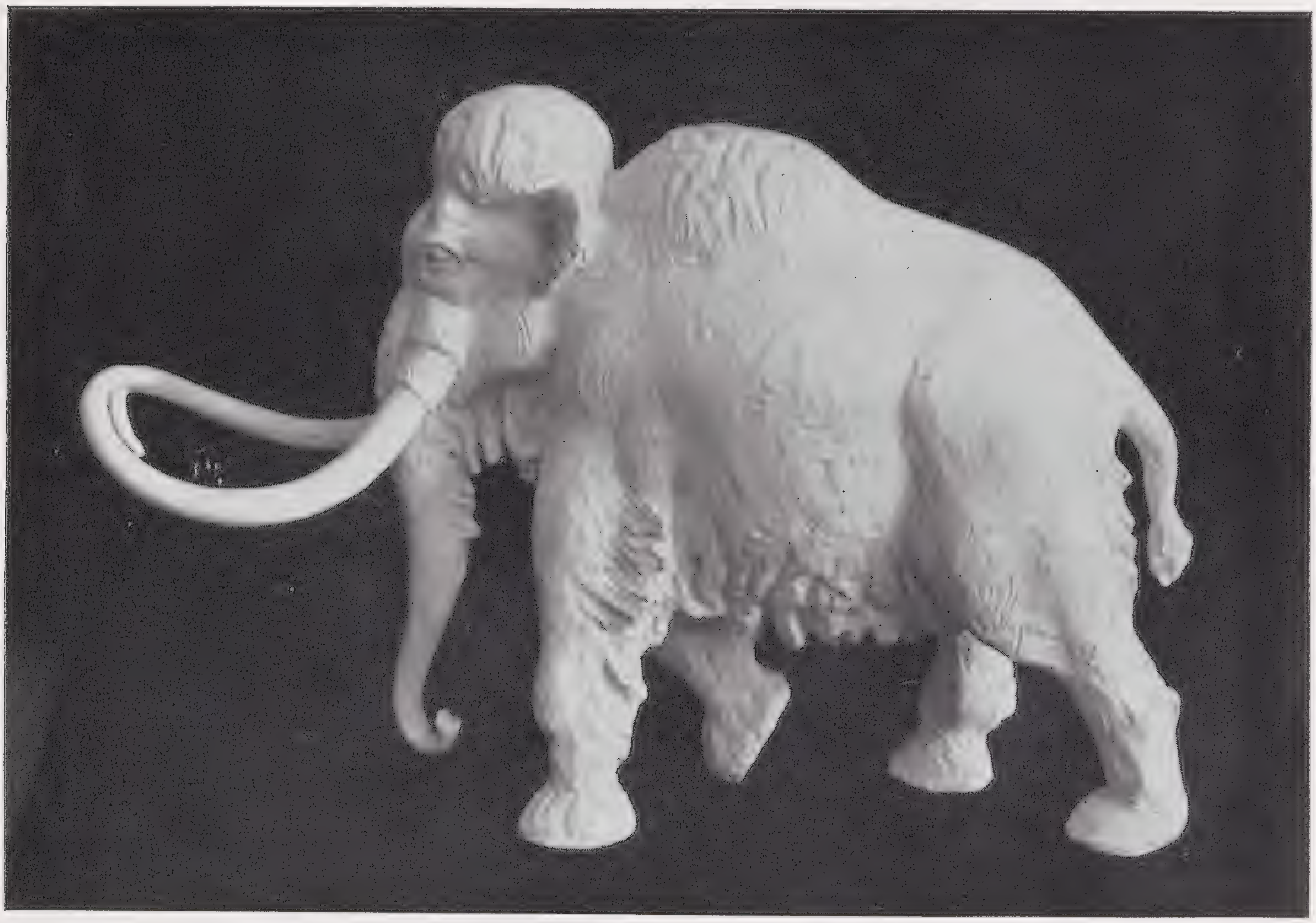
To enable them to obtain the daily need of flesh, they must use every wile which their strange world permits. Those which are blind must reach out and locate their prey by means of long, slender tentacles and finger-like fins, swimming along in absolute darkness, ready to turn and snap at the first hint of food. Others, with eyes infinitely bigger than those of the

A "tree-carrying" anglerfish attacks two giant scarlet shrimps a half mile below the surface. The shrimp defend themselves by pouring forth a dense cloud of blinding luminescence.

In the black depths of the sea a scarlet squid, covered with lights of green and blue, seizes and devours one of a school of silver hatchetfish.

pseudo-loup-grandmére of the fairy tale, carry beacons and batteries of search-lights which spy out the watery spaces, and cut down the hope of life of an infinity of beings, whose only sanctuary is the eternal, undisturbed darkness. Food in these abysses is often scarce, and when detected is of such great size that a creature of the upper air and waters would turn away in despair at its own diminutiveness, or flee in terror at encountering a potential foe three times its own length. But not so the gulpers or some of the anglers. They are practically all mouth and the prospect of attacking and engulfing a meal, active and swimming, with perhaps a good armature of teeth, two or even three times the length of their own body, ten or twenty times their bulk, does not for a moment deter them. And there is no attempt at devouring it piecemeal as a shark or tiger dismembers its prey. It is all or nothing—and with these deep-sea gourmands it is invariably all.

Then eels appear through the murk, slender, silvery, splinters of life, with elongate jaws like recurved needles, eels which feed daintily, snipping minute organisms here and there. And again the fishing frogs (for lack of any other understandable name) which are round and fat, and whose small fins keep them ever in low gear. These must entice their game, decoy their diet, and are provided with an assortment of lures and bait which would drive any human fisherman crazy with envy. Their brethren of well-lighted surface waters use bits of their own worm-like flesh, which they tantalizingly twist and wriggle about at the tips of slender rods. But down here the sun and moon and stars never shine, and only when I once reached a half mile depth in the Bathysphere, had any artificial illumination ever before broken through the more than stygian darkness. Here the piscine anglers call upon the jacklight principle, and deck their worms and wrigglers and imitation shrimps and



Woolly mammoths migrated from what is now France across Europe, Asia, the Behring bridge to Alaska and on eastward. Only twenty miles from Broadway one of these giants bogged down in North Plainfield, and has been reconstructed from bones, teeth and tusks.

fish (all flesh of their flesh) with brilliant lights of purple and pink, green and white.

The extreme of *laisser faire* anglers paints its teeth with golden luminescence and, opening its cavernous mouth to full extent, allows all incautious approaching titbits, who love light, to swim in and down its throat. It probably, now and then, has to go to the trouble of swallowing, otherwise its shopping, cooking, and devouring of meals is automatic, a dynasty of perpetual motion, ceasing only upon the death of the robot angler, shall we hope from very surfeit?

If by chance we have our home in Philadelphia, Atlantic City or Hartford, we are farther away from New York City than the haunts of these goblin, abyssal hosts. We know and have named a few; many others are awaiting discovery; capture by means of our slow-moving, clumsy nets; and the study which will enrich our store of human knowledge, do its bit to satisfy our eternal curiosity, and enhance our belief in fairy tales.

The first large diorama of the Department's exhibit in the Zoological Society's building represents various prehistoric, extinct mammals, on the bank of the Hudson with the palisades in the background.

In the second we see New York when Long Island was one hundred miles inland, and when the Hudson River Gorge was being cut deep and wide across this expanse. At that time not only the Connecticut, Hoosatonic, Passaic and Hackensack emptied into the Hudson, but even the waters of the Great Lakes far to the north poured southward into its channel. Today, if we scraped out the glacial detritus from the bed of the Hudson opposite New York City, it would be found to be seven and eight hundred feet deep, and only a short distance south of Long Island the Gorge is actually hundreds of feet deeper.

A third diorama is of New York and its vicinity today, with the Gorge sunken below the water. Out upon the surface of the ocean we see facsimiles of the boats used by the Zoological Society in trawling, dredging and diving: the *Gladisfen* trailing six deep-sea nets, and the *Ready* with the Bathysphere dangling far below her keel.

The remaining half of the exhibit of the Department of Tropical Research is contained in a large circular room called the Bathyspherium. From the center hangs the Bathysphere itself, the same sphere in which Mr. Barton and I descended into the sea off Bermuda to a depth of half a mile. Its cable and hose stretch up into blackness, as they did when we were dangling far below the surface.

The Bathyspherium has been arranged and lighted so that when the visitor enters, he is made to feel that he is actually in the water of the ocean, more than 3,000 feet below the surface. Around the walls are photographic transparencies depicting various activities outside and inside the sphere. Alternating with them are four dioramas, lighted by ultra-violet light, showing some of the unbelievably strange creatures living today within one hundred miles of New York and the grounds of the World's Fair. Several illustrations herewith reproduced show these dioramas photographed by their own ultraviolet light. It is believed that these representations are the truest and most vivid ever made of the life which exists in the abysses of ocean. They are built to last, and when the Fair closes they will be exhibited in the Zoological Park.

All the exhibits of the Department of Tropical Research have been conceived and constructed by members of our own staff. The models of the extinct fauna as well as all the deep-sea fish and other creatures have been made by Mr. Philbrick Crouch, who was a member of the Department's expedition to Bermuda in 1930; Mr. Crouch is also responsible for the delicate ultra-violet painting. The backgrounds of the larger dioramas are the work of George Swanson and Mrs. John Tee-Van, while Mr. Tee-Van has had charge of the foregrounds of the Hudson Gorge dioramas. It is a matter of considerable pride that in the skilled construction of this whole exhibit we have not had to go outside our own department.

In the general planning of the two rooms of exhibits, I have tried to achieve continuity in each successive phase of presentation of Unseen Life of New York City, isolated by Time and Water. I have wanted it to convey to the visitor some significant meaning: some idea which would remain in his memory and inspire him to make use of the Zoological Society in the future. This would do much to increase our educational possibilities and to sustain the high plane of excellence which makes the Zoological Society one of the foremost cultural institutions in our city.

A Visit to Bird City on Avery Island

Thousands of Egrets, Herons and Anhingas Nest Annually In a Sanctuary Created for Conservation Forty Years Ago

Claude W. Leister

FEW American naturalists are unfamiliar with the name "Avery Island," and practically all of them know that it is located on the Gulf coast, in Louisiana. However, it is safe to say that, outside of those who have actually visited the place, few realize it is not an island at all but rather a mountain. Actually, and geologically speaking, it is a salt plug, first thrown up as an island and now surviving as a series of closely-connected hills projecting above the surrounding silt plain. It is several miles inland from the waters of the Gulf. The entire area is covered with dense, semi-tropical vegetation.

The presence of salt at Avery Island has been known since Revolutionary times but no particular use was made of the deposit until after the Civil War. Actual mining operations were started about fifty years ago and the mine is now operated by the International Salt Company. The area of the deposit is said to be approximately a thousand acres, extending to an unknown depth, but at least to 2,200 feet, the limit of exploratory drilling. Since the average daily output is 1,500 tons, and only sixty acres have been worked, at a single level, in forty years, the eventual exhaustion of the supply by present mining methods is problematical.

Avery Island is noted for three other things in addition to its salt, namely: tabasco sauce, the egret colony "Bird City," and, in recent years, its Jungle Gardens. Tabasco sauce, familiar to most of us, was the invention of a Judge Avery, who then owned the island, and his son-in-law Edmund McIlhenny. After the Civil War this pungent sauce did much toward reestablishing the family fortunes. The Jungle Gardens and Bird City are both the handiwork of Edward Avery McIlhenny, a grandson of tabasco-inventor Edmund, and the present lord of the manor.

The McIlhenny fortune has for years been used to back the development of one of the most remarkable gardens in the south. Some two hundreds acres are devoted to extensive plantings of thousands of species of native and exotic plants, skillfully located in moss-grown forested areas. The Jungle Gardens are visited annually by thousands of persons from all over the country and are justly the pride of their creator.

My recent opportunity to visit Avery Island more or less appeased an inner urge that had existed for a number of years. The history of Bird City has been such that anyone interested in wild life conservation has become desirous of visiting that place now so widely noted as a prime example of practical and effective conservation. Indeed, Avery Island probably offers our best example of what can be accomplished in establishing a bird sanctuary—starting from scratch and ending up with the real thing.

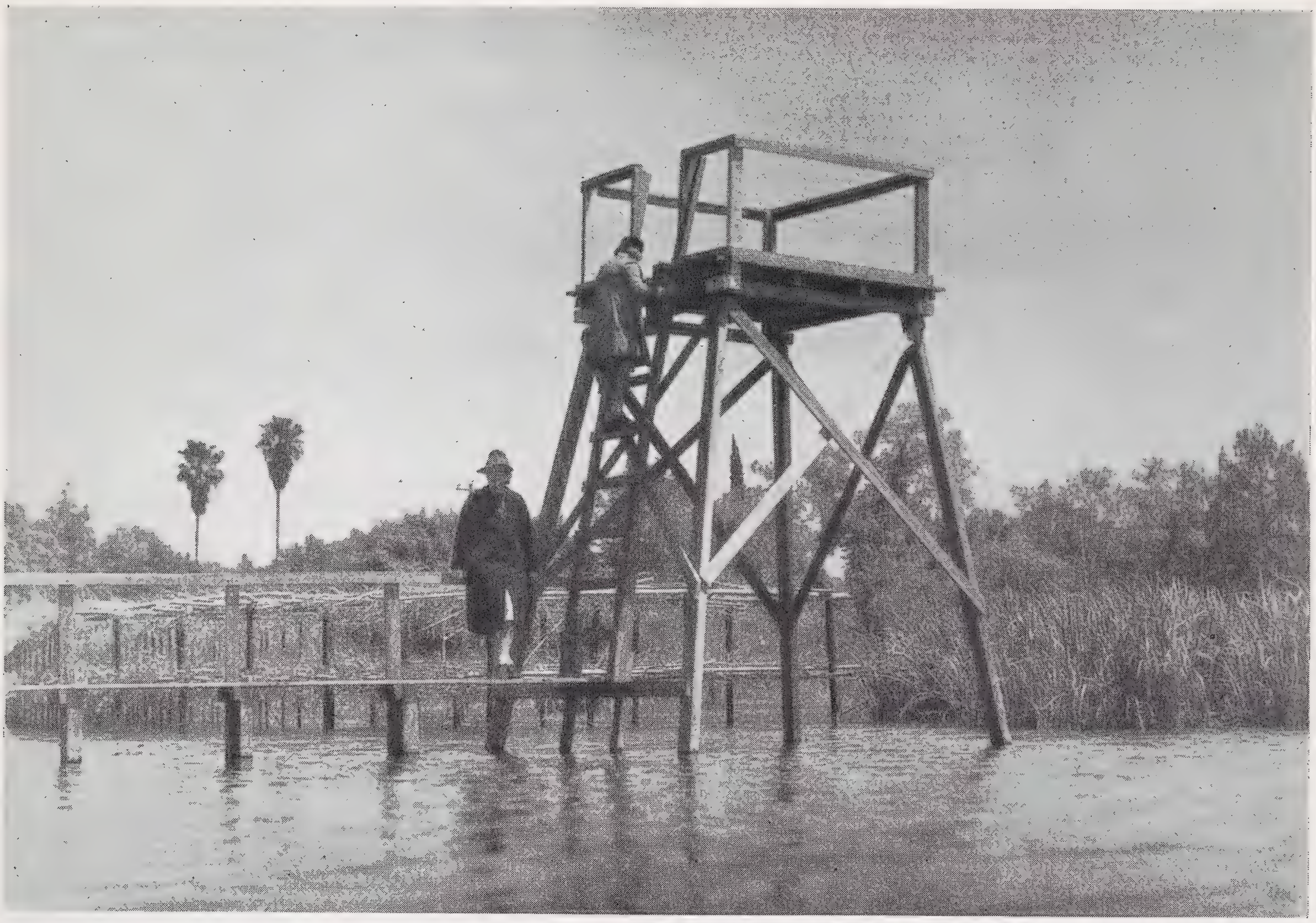
Bird City is not a natural breeding area, selected by the birds themselves, but, as we see it today, it is the result of the hard work and intelligent planning of one man, Mr. E. A. McIlhenny. On this site, formerly only a few native birds were to be found along a meandering stream. Now there is a thirty-five-acre lake with several thousand pairs of snowy egrets, American egrets, Louisiana herons and anhingas or snake birds.

Some forty years ago Mr. McIlhenny was keenly interested in the probable fate of the snowy egret—then practically exterminated by plume hunters. He was born on Avery Island, and as a youth had formed an everlasting attachment for these graceful white herons. About the time he went north for his education the wearing of feathers on hats and for other adornment had become the height of fashion. Because of its nuptial plumes or aigrettes, one of the principal sufferers from this trend had become the snowy egret. On his return from college he found that the plume hunters had almost exterminated them. Most of the nesting colonies he had known had been completely wiped out. He became a rabid, rampant conservationist and did all within his power to put the plume hunter out of business. Many years ago he supervised a motion picture showing the nefarious trade in all its bloody details. This was the first conservation movie ever made and its showing before Congress and other legislative bodies helped materially to pass legislation prohibiting the sale and wearing of the plumage of wild birds.

Mr. McIlhenny was not satisfied with legal efforts alone and resolved to do something more practical for his feathered friends. The idea for Bird City came into being. He reasoned that it might be possible to start a colony of snowy egrets near at hand, where they could be protected. A small lake had been made by damming a stream near the McIlhenny home. In 1892 he built a small wire enclosure along the bushy border of the lake. Eight young birds were located in an isolated swamp, brought home and placed within the enclosure. Here they were cared for every day by Mr. McIlhenny. By fall they had reached maturity.

Mr. McIlhenny knew that his birds were migratory and that they would have to leave for

This is only one small corner in the egret colony at Avery Island—and not a thickly populated corner either, for the birds that were nesting in the immediate foreground were frightened away by the approach of the photographer. All these birds are the small snowy egret.



The observation tower at Avery Island is near one end of the nesting lake and from its top visitors can look out over the entire colony without getting close enough to alarm the birds. Artificial nesting sites can be seen not far above the water at the middle left.

the winter and return again in the spring before he could begin to hope for the success of the experiment. So, in October, the cage was torn down and the egrets were freed. They lingered for several days until a cool, frosty morning found them gone.

Needless to say, Mr. McIlhenny was more than delighted when four of them returned the following March—to the same bushes where their rearing cage had been located. A few days later two more appeared. One of the six birds subsequently disappeared, probably the prey of some marauding animal, but the remaining two pairs nested and reared eight young egrets. In the fall thirteen birds, young and old, took off for South America.

Bird City on Avery Island was an accomplished fact. It became larger from year to year. The original small lake was outgrown and twice enlarged, until today it covers thirty-five acres. For some years the natural fringe of bushes around the lake offered an insufficient number of nesting sites. To remedy this condition a supplementary nesting area—a double-decked structure of bamboo, loosely floored with brush, was erected just inside of the marginal fringe of vegetation. Rather strange to say, this artificial nesting site was readily accepted by the birds. In a few years it, too, had to be enlarged. Now there are two such structures, a hundred feet or more in length, accommodating several thousand egrets. To the visitor, the sight of perfectly wild birds nesting under such artificial conditions is one of the most remarkable features of Bird City.

Along with the lack of natural nesting sites in the rapidly growing colony, nesting material likewise was at a premium. Mr. McIlhenny caused piles of twigs and small sticks to be placed here and there through the area. Such benefactions now amount to approximately thirty truckloads annually.

Our two-day visit to Avery Island on April 9 and 10 found nesting operations at Bird City in full sway. Several hundred snowy egrets were certain to be in full view in whatever direction one might happen to look. There was a considerable amount of gossipy squabbling among neighbors, with here and there a determined set-to, with magnificent thrusts and parries by black rapier-like bills. Above all was a discordant clucking issuing from thousands of throats.

We saw mostly snowy egrets but there were also a number of American egrets, the latter congregated in small groups somewhat aloof from their smaller relatives. Louisiana herons were the most unafraid of all and allowed a close approach before leaving the nest. On an island in the middle of the lake a dozen of the curious anhingas or snake birds were sunning themselves in characteristic fashion. Others were soaring in great circles, like vultures, high up in the blue above. A short trip, by punt, across the lake to the far corner of the sanctuary surprised a large alligator, which took to the water with a frantic scramble, barely clearing our bow. (We surmised that numerous helpless young herons had contributed to the size of this fellow.) Blue herons, gallinules, coots and cinnamon-winged teal completed the fascinating picture.

At Avery Island the bird lover can find plenty that is satisfying. Our visit was made in time to see part of the spring migration. The different species observed en route were an interesting mixture of southern and northern forms and without any particular effort 64 species were listed. The immediate setting is perfect for a bird sanctuary. While observing the waterbirds, cardinals and mockingbirds were calling from the shore and a pileated woodpecker flew across the lake. It is doubtful if one can find anywhere a more remarkable combination than McIlhenny's Jungle Gardens and Bird City.

One of the several thousand nests of the snowy egret. The natural growth of bushes around the lake cannot furnish an adequate supply of sticks for nests, so about thirty truckloads of small branches are deposited around the lake each season for the birds to carry away.

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All pictures not otherwise credited are from the photographic collection of the New York Zoological Park and the Aquarium.

NOTES FROM THE ZOOLOGICAL PARK, AQUARIUM & DEPARTMENT OF TROPICAL RESEARCH

Spring Babies

Three Yellow Paradoxures (*Paradoxurus hemaphroditus*) were born on June 2, the first of their kind born in our collection. The family is on exhibition in the Small Mammal House.

A young Lechwe Antelope was born on April 28, the second offspring of a pair that has been in the collection for some years. When the first baby arrived about two years ago, the father tried to kill it. The arrival of the second he took more calmly.

Two chicks of the Great Argus Pheasant were hatched at the Pheasant Aviary this spring. One was lost during its first few days, but the other is coming along nicely. Great Argus chicks have been successfully reared in the collection twice before.

Nesting Time

The big Flying Cage is well-dotted with nests this spring, and if the weather does not turn unseasonably cold there should be an interesting display of young birds soon. The nesters include a pair of American Egrets, two pairs of Snowy Egrets, three pairs of Silver Gulls and a Sacred Ibis and an Indian Black-headed Ibis which mated and reared a family last year.

Book-at-a-Bargain

The covers of about sixty copies of "Tropical Wild Life in British Guiana" by William Beebe, G. Inness Hartley and Paul G. Howes were waterstained some time ago and the Department of Publication consequently offers them for sale at the bargain price of 50 cents each. The regular price of the book is $3.

"Tropical Wild Life" is a book of 504 pages, elaborately illustrated, with several plates in color. It presents the early research of the Department of Tropical Research in British Guiana, its purpose being, in Dr. Beebe's words, "to delineate as concisely and vividly as lies in my power, the general aspects of the tropical jungle and its animal life as far as these came under our observation, and to emphasize the manifold interest and the paucity of dangers which it offers to the scientist or nature-lover."

The waterstained books are only slightly damaged, in most cases the water having discolored the binding just enough to make them unsaleable as new, fresh copies. At the price of 50 cents cash, check, money order or stamps must accompany the order. We pay the postage.

Living Ghosts

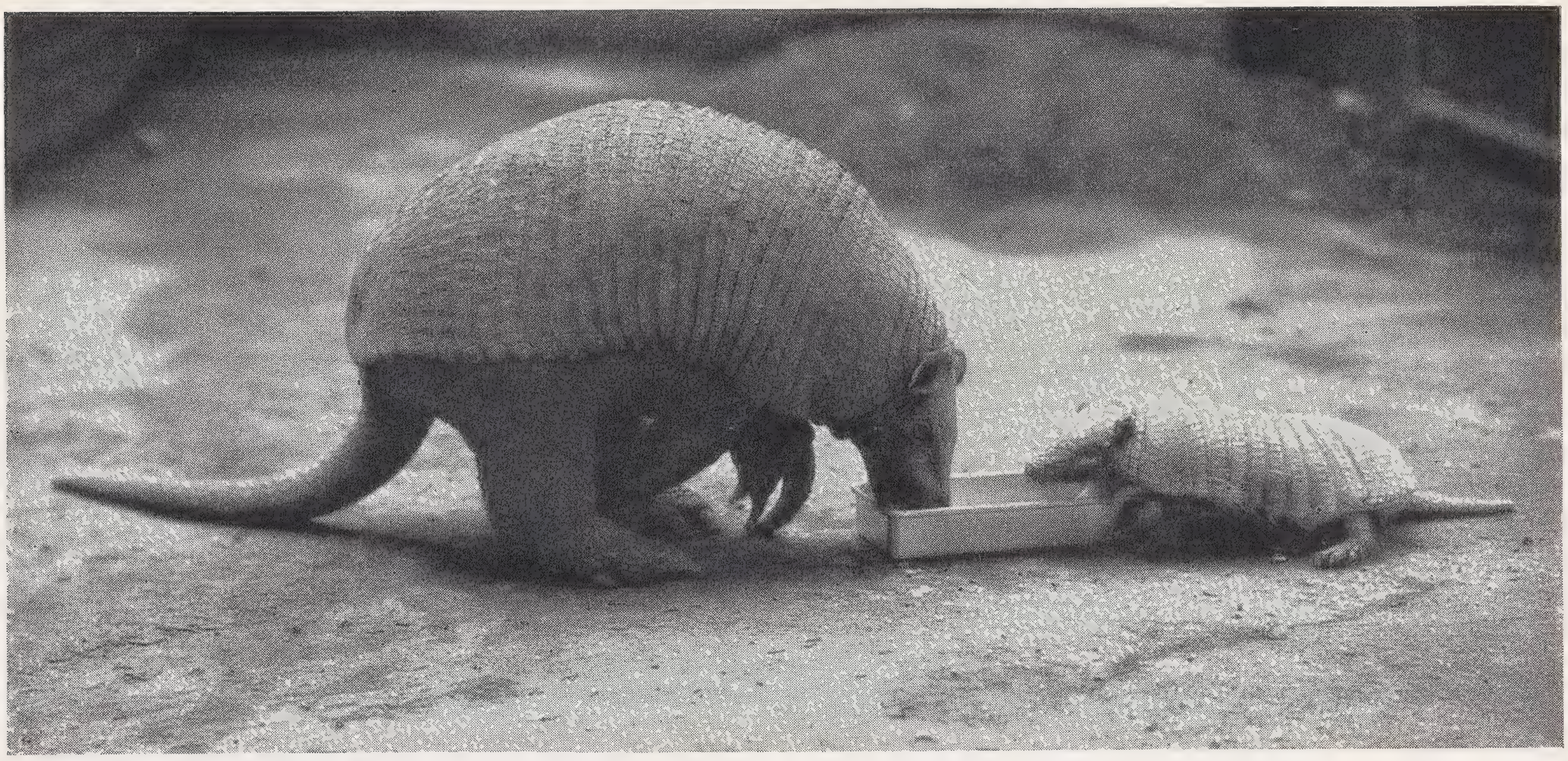
The Aquarium again, after an interval of several years, has specimens of the olm, the famous blind salamander from the caves of south-central Europe. Dead white in color with blood-red gills, they crawl in and out of the fresh-water mussel shells on the bottom of their darkened tank or swim spectre-like slowly through the water. They are totally blind, what little remnants of eyes they have being completely hidden under the skin. Although confined to cold, lightless, subterranean waters in nature, they do surprisingly well in captivity.

The olm, *Proteus anguinus*, has been the subject of many a lively scientific discussion. Did it become blind *before* or *after* it took up life in caves? Did it resort to cave life because it had faulty vision or did degeneration of its eyes take place under the influence of a lightless environment? These questions have not yet been definitely answered and when they are something very important to the concept of evolution will have been discovered. Olms kept in the light do develop pigment in their skin, but not eyes. Nevertheless, in young specimens the eyes are more exposed than in adults.

Our specimens are about nine inches long. According to reported evidence, they may double their present length. Their natural food consists of small crustaceans. They lay eggs which are fastened to the underside of stones.—J. W. A.

Among the new arrivals at the Zoological Park during May was the largest specimen of the African Puff Adder that the Reptile House has ever exhibited.

The series of fifteen lunette-shaped murals between the heads of the columns of the outer ring in the exhibition hall of the Aquarium has been completed. The final painting was put up on April 18. Charlotte Chase Ward of Scarsdale, New York, started the difficult task of fitting suitable subject matter and artistic composition into the panels in 1933. The murals portray representative invertebrates of the sea in characteristic situations and associations. Octopuses, crabs, shrimp, jellyfishes and corals are but a few of the many backboneless creatures pictured. The appearance of the hall has been no little enhanced by the transformation of what was once blank wall into instructive and attractive illustrations of marine life.



The Giant Armadillo really shows his size when he feeds alongside his relative, the familiar Nine-banded Armadillo.

PUBLICATIONS OF INTEREST

WHAT SNAKE IS THAT? By Roger Conant and William Bridges. 156 pp., 108 line drawings by Edmond Malnate. New York: D. Appleton-Century Co. $2.00.

I venture to guess that the people of this country are well on the way to overcoming their unreasonable fear of snakes. The appearance of "What Snake Is That?" further convinces me that my guess is a safe one. Not many years ago no publisher would have been interested in such a book because then it was considered sufficient to exclaim "That is a snake." Any fool knew enough to reach for the nearest stick or stone.

It is hard to persuade the layman to identify a snake, because its points or "characters" are new to anyone not familiar with these reptiles. The description of even a mouse must of necessity include many familiar terms, but not that of a snake. The authors of "What Snake Is That?" have eliminated a good deal of this difficulty by making full use of geographical distribution. Thus, one finding a snake in the northeastern states has only to look for it among the species found in their "Area 1." Obviously the drawback here is the impossibility of identifying individuals of unknown origin.

Keeping matters on a level requiring the minimum amount of snake knowledge, the authors next require the recognition of only two technical characters, both of them easy enough. After this, coloration alone is used. Here a little maneuvering is necessary when two kinds happen to have similar types of pattern. Again a drawback lies in the great degree of simplification employed. For example, the Massasauga appears as merely a "blotched or plain" snake with no mention of the rattle. Such an outstanding character might well have been added in boldface type.

After determining the name of a snake, one finds on the page indicated a description of it as well as a readable summary of its habits and distribution. The book, then, is considerably more than its title implies. For the great majority of kinds the description is supplemented by a semi-diagrammatic drawing of the color pattern.

Scientifically accurate and up-to-date, this work is written in a strictly non-technical style. Both of the authors are well qualified by long zoo experience to tell what the average man wants to know about snakes and the senior author is a herpetologist of high standing. All the species and subspecies found east of the Rocky Mountains are included. The full emphasis placed on the latter contrasts rather sharply with the generally simplified contents. —CLIFFORD H. POPE.

REPTILES AND AMPHIBIANS. By Workers of the Federal Writers' Project of the Works Progress Administration in the City of New York. Ralph De Sola, Editor. 254 pp., illus. Chicago: Albert Whitman & Co. $2.25.

The new volume from the WPA writers' project, entitled "Reptiles and Amphibians," is attractive in its preparation and should be a useful reference book. Also, there is much in it that has been arranged in smoothly readable terms. The authors have brought together an elaborate series of photographs from various sources. The preparation of such a book is a quite formidable task, but here Mr. DeSola has been guided by his extended studies of reptiles and amphibians, about both of which groups he has done considerable writing.

In preparation of the text, with exception of the headings of major groups, there is little use of scientific names. This appears to have been done in creating smoother readability. Throughout the illustrations, however, there has been meticulous care in the presentation of scientific names and these are strictly up to date. The book includes representative reptiles and amphibians of the world, some of the descriptions naturally much condensed. There is a section dealing with treatment of the bites of poisonous snakes.

—R. L. DITMARS.

Serpents of the Northeastern States

By RAYMOND L. DITMARS

HERE is a comprehensive, yet compact, book about the snakes of the northeastern states that will prove to be extremely useful to everyone with a summer home or camp in that region. This guide to the venomous and non-venomous reptiles of the New England area, New York, New Jersey and eastern Pennsylvania, is a practical and handy reference work. It gives a key for ready identification of snakes, descriptions of their feeding and breeding habits, notes on distribution and photographs of every species found in the northeastern states, including color plates of the copperhead and rattlesnake. One section is devoted to the emergency treatment of snakebite.

"Serpents of the Northeastern States" was originally published as a complete number of the BULLETIN and several reprintings were quickly exhausted. It has been republished in a new format, somewhat revised as to text and nomenclature, and four photographs have been added.

60 pages, 41 illustrations. *50 cents postpaid.*

Department of Publication & Photography
NEW YORK ZOOLOGICAL PARK
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PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Forty-one volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XXIII are complete and indexed. Volume XXIV will be issued during 1939, in quarterly parts. *Zoologica* is sent to members on request.

[*Zoopathologica,* Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica. Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report, Zoologica* and *Zoopathologica,* as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to Publication Office, Zoological Park, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

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NEW YORK ZOOLOGICAL SOCIETY

XLII, No. 4

July-August, 1939

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

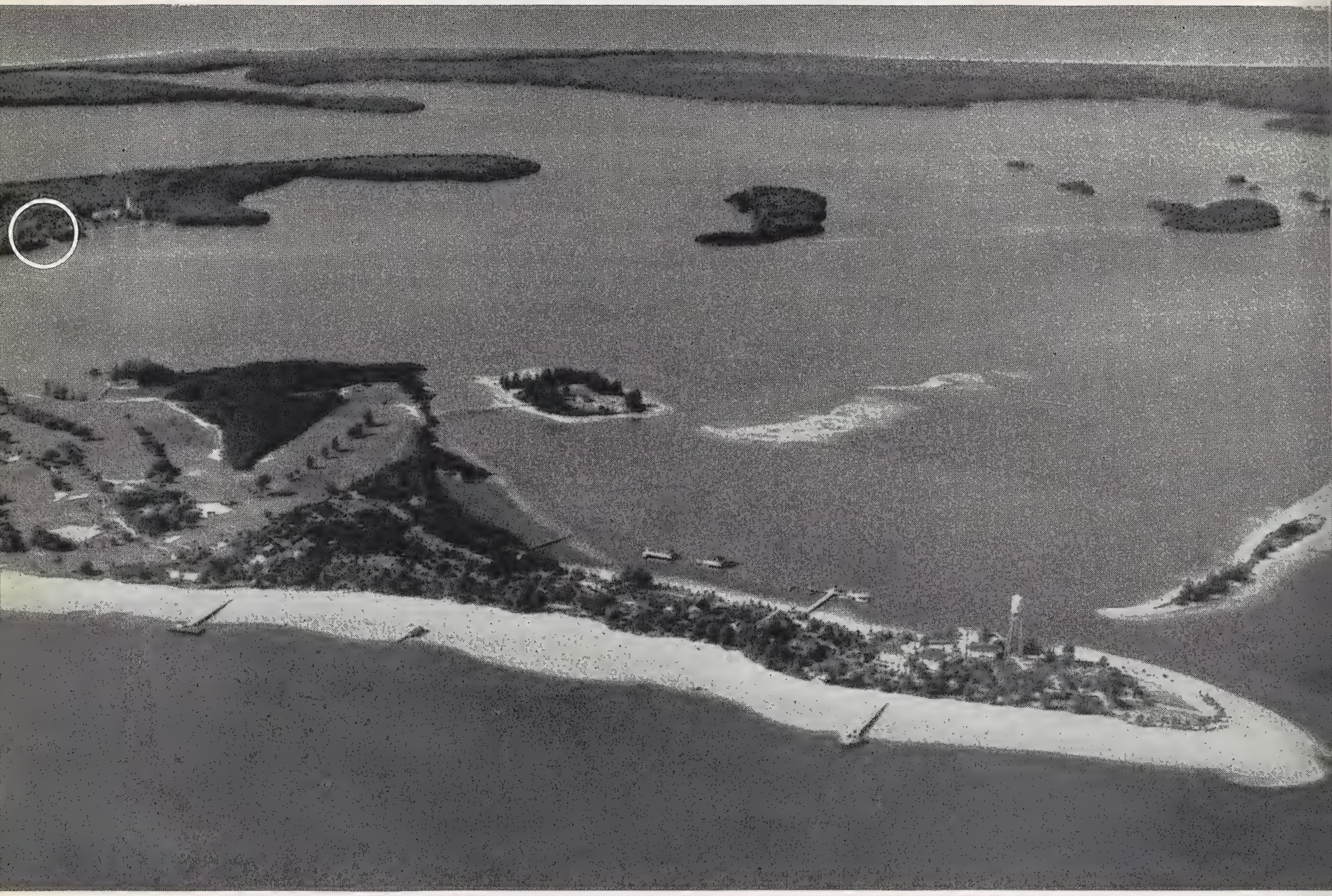
Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



Courtesy Fort Myers *News-Pre*

This is an air view of the Florida coast region where the Aquarium is pursuing its studies of the tarpon. Inside the white circle are the laboratory and dock on Palmetto Key. The large island in the foreground is Useppa; Boca Grande Pass is not far beyond the right side of the picture; the long island in the background is La Costa and beyond it is the open Gulf of Mexico.

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On the Trail of the Tarpon

The Early Stages in Its Life History Have Long Been Secret, but the Aquarium's Florida Research Station Is Making Progress

Charles M. Breder, Jr.

ALTHOUGH the tarpon is a well-known anglers' fish and has had a large following of sportsmen for many years, there is still surprisingly little accurate knowledge of its manner of life. While the anglers have built up a large body of information on the technique of capture, even to the point of formalizing the sport into annual tarpon "rodeos," biological information on the species is still all too scant. Aware of this condition, the late Mrs. Gratia Rinehart made it possible for us to undertake a study of the tarpon, with a view to working out the life history and general habits of this strikingly handsome species. Work was actually undertaken scarcely over a year ago and the present writing is in the nature of a report on the progress of this study.

The first move was to establish a field laboratory adjacent to the home waters of the tarpon. In this we were extremely fortunate, since establishment of our headquarters was possible on the sponsor's own island, Palmetto Key, Florida, a scant four miles from Boca Grande Pass, a favorite rendezvous of tarpon anglers. The island is as close to this pass as is Useppa Island, another prominent base for the anglers. In fact, the two islands are separated by less than half a mile of water and it is little further to Mondogo Island, the home of Mr. Murray Coggeshall, president of the Useppa Tarpon Club. Both Mr. and Mrs. Coggeshall gave valued assistance in various phases of the work, as did many others interested in such matters. It will have to suffice here to mention Mr. Whittemore, who made available the use of his extremely able cruiser for visiting the more distant points, Mrs. Mary Roberts Rinehart, who supplied us with a very handy small boat and outboard motor and who gave much valuable advice, Dr. L. M. Perry, who rendered great aid at Sanibel Island, and Mr. R. M. Carpenter, to whom goes the distinction of tagging the first large-sized angler's fish. Mr. L. L. Babcock, author of "The Tarpon," and an ardent angler of wide repute, cooperated in the spring season and rendered much aid to the project.

During the summer of 1938, we were fortunate in obtaining the services of Marshall Bishop and Mrs. Bishop through the good will of Professor A. E. Parr, director of the Peabody Museum of Yale University. The Bishops occupied the field from June 27 to August 27, and in addition to their proper field activities superintended the construction of the laboratory. Their chief activity regarding tarpon centered around the tagging of young fish, but they also made a large general collection of fishes and invertebrates from this region in which, scientifically speaking, there has been scant study.

In the tagging operations, which really forms a separate story, the United States Bureau of Fisheries is cooperating. The tags used are the official government tags, an item of considerable psychological importance to the captor. One important problem involved in this study concerns the movements, migrations and growth of

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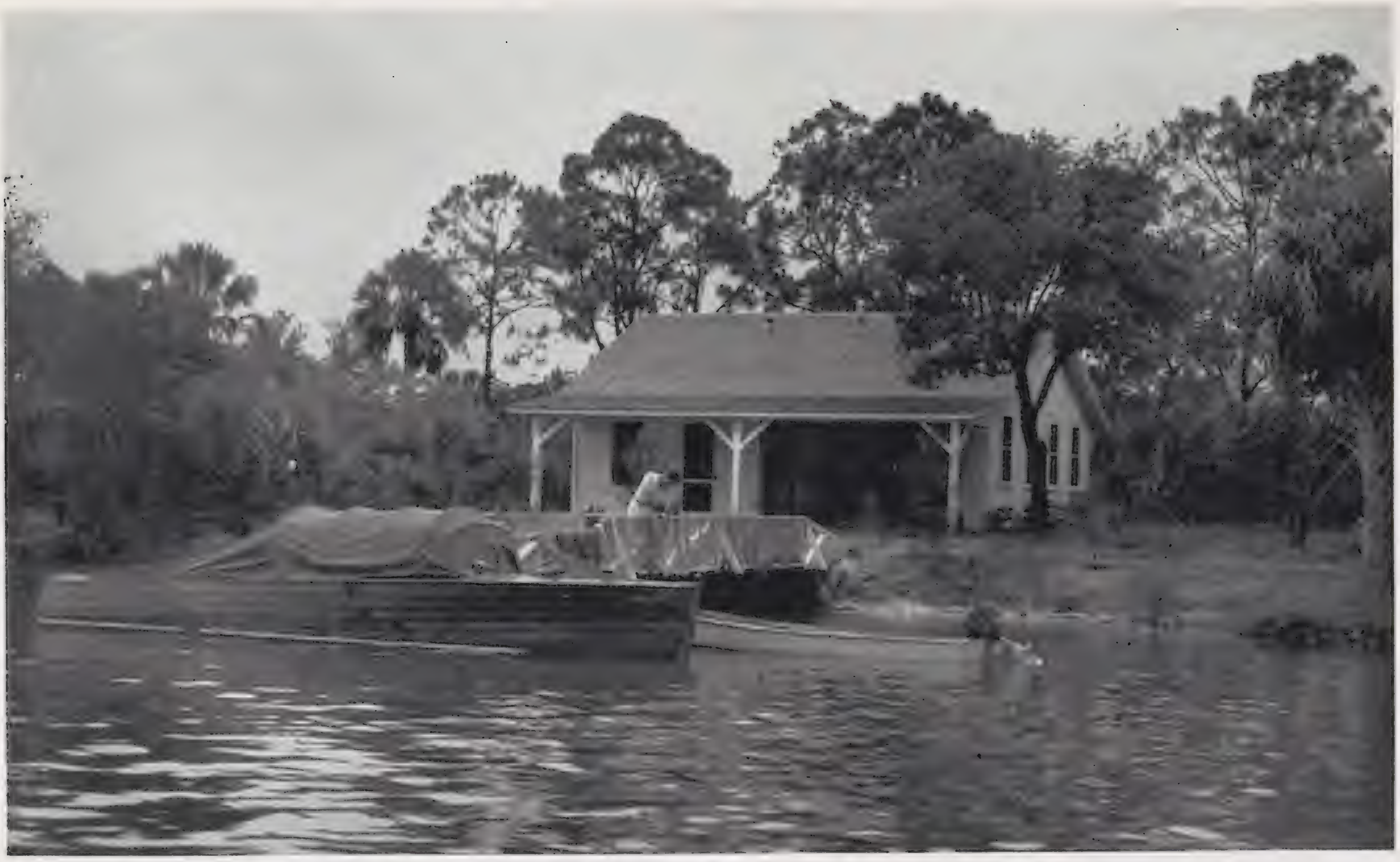
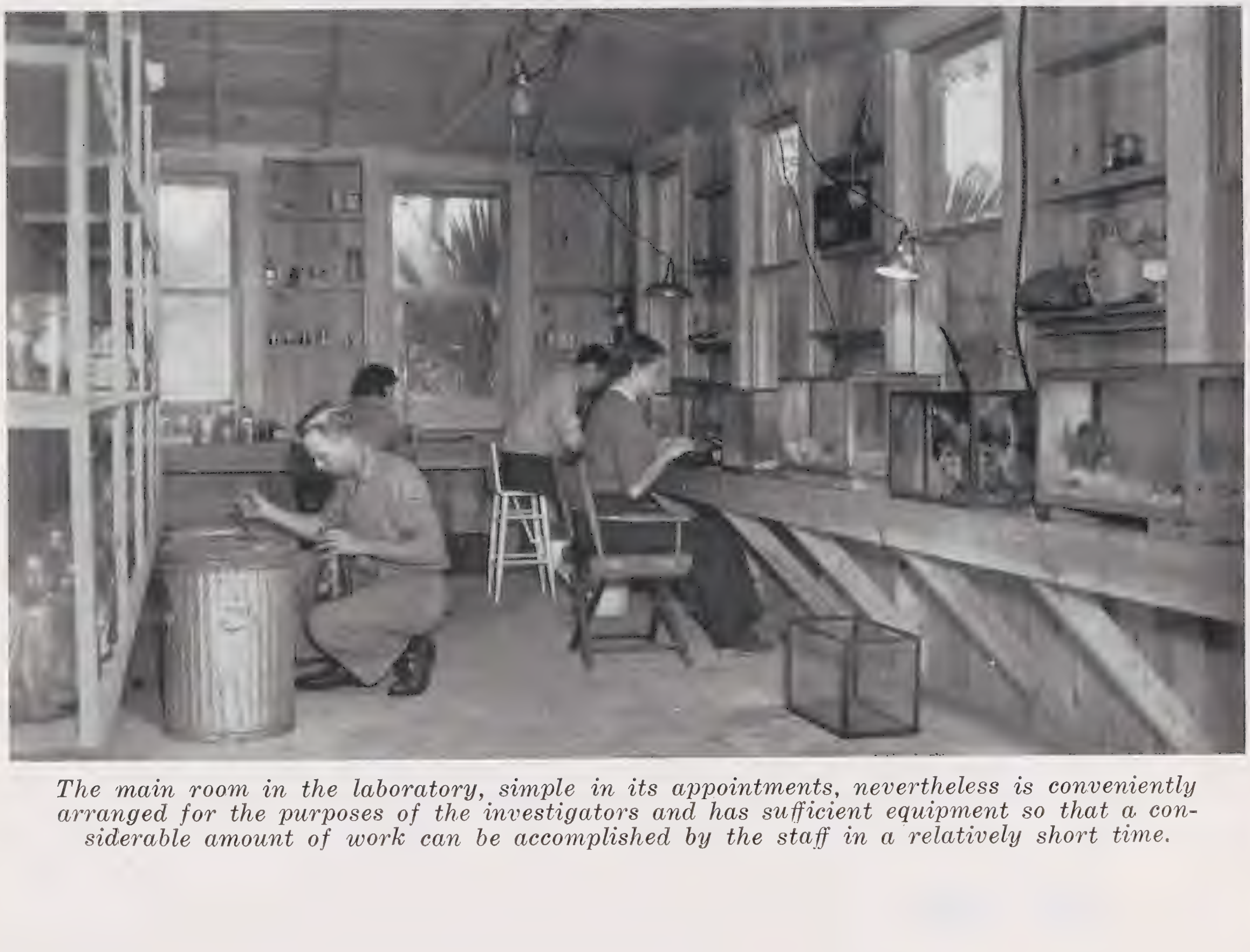


The Palmetto Key laboratory and its two boats at the dock. The larger one is used chiefly for working in and about the passes and the smaller one, supplied by Mrs. Mary Roberts Rinehart, is invaluable for working in tight, shallow places among the mangroves.



The main room in the laboratory, simple in its appointments, nevertheless is conveniently arranged for the purposes of the investigators and has sufficient equipment so that a considerable amount of work can be accomplished by the staff in a relatively short time.

The interior of Palmetto Key in the main presents this kind of a picture. Back from the shore these low-lying islands are semi-arid and support a tangled profusion of vegetation that can withstand long periods of drought. Spanish moss occasionally drapes the limbs.

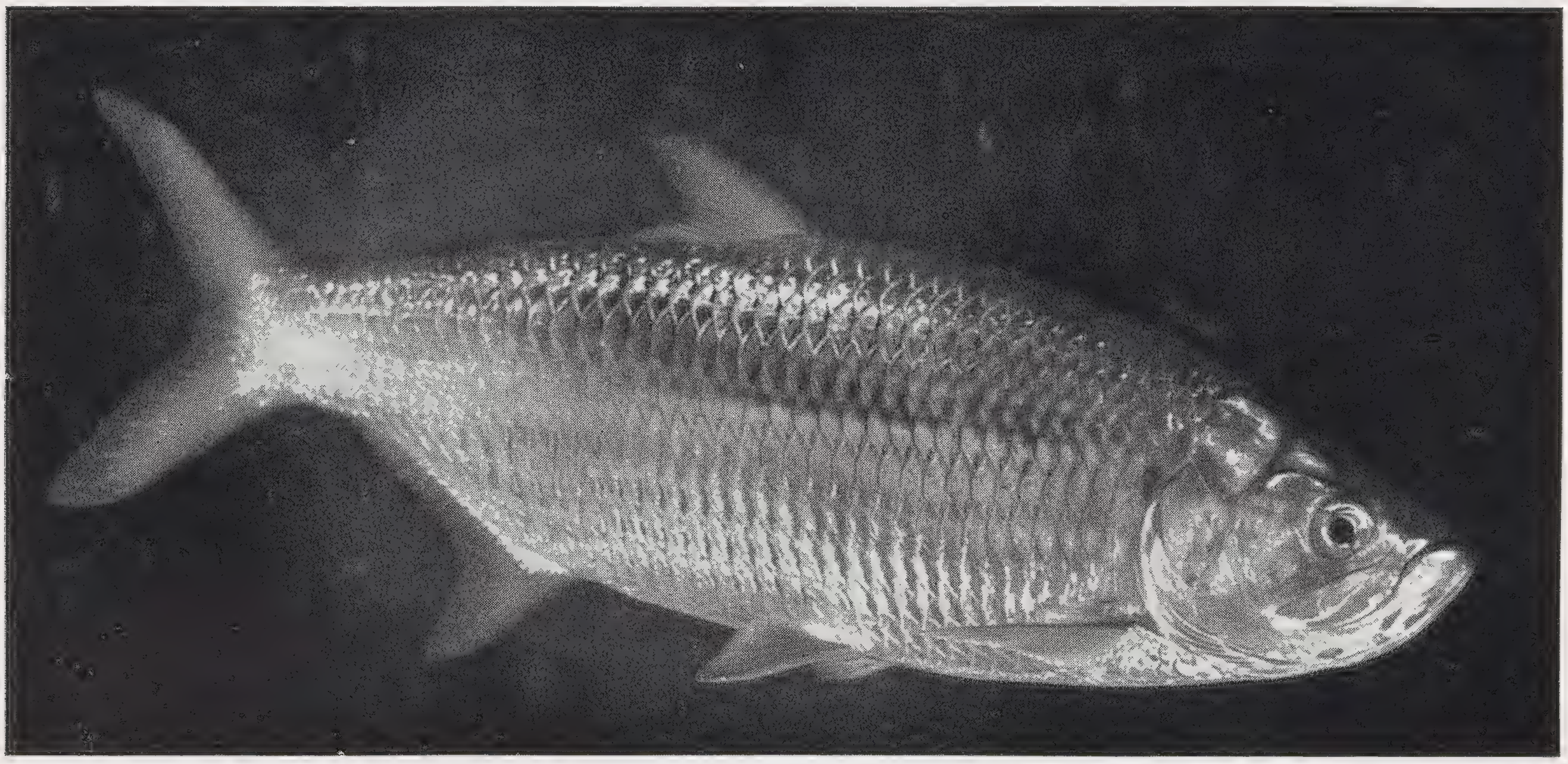
A pool for holding young tarpon under study was needed, and so this artificial one was dug close to the laboratory. It closely resembles many of the natural ones in which young tarpon are found. The ripple in the foreground was caused by a tarpon coming up for air.

the species, an item on which the technique of tagging has great bearing.

It so happens that young tarpon in their earliest stages are quite unknown, but when they reach a length of about seven to twelve inches they are evident enough in certain places. Strange as it may seem, these places are frequently unpleasant swales, disconnected from the sea, turbid and sometimes evil smelling. These pools are relatively numerous on this low land, forming a much dissected coast line. Some are just a few yards from open waters on the numerous islands or on the mainland. From such locations they extend inland until they grade insensibly with the fresh-water pools of the Everglades. Avoiding for the moment the question of how the little tarpon get into or out of such places, it is enough to mention that they formed the basis of active tagging operations. During the 1938 season, 358 fish from these places were tagged—no small undertaking, and one for which Mr. Bishop deserves great credit. Catching the alert and wary tarpon in nets in such places, in which the nets snag on mangrove roots at every turn, in the middle of August with mosquitoes at their worst, is no job for softies.

Some of the tagged fish were returned to the ponds from which they were taken, while others were released in the sea at the nearest point possible. The former were used to check on the durability of the tags and on growth rates in these land-locked pools. Two types of tags were used, one a strap-like metal clip placed on the edge of the gill-cover, and the other a cuff-button-like tag placed on the gill-cover. The latter, made of celluloid, are clearly preferable, on all counts except ease of attachment. Fishes remaining in certain pools showed no growth at all while in others a fair amount was noted on recapture this year. This is what should be expected in view of the fact that these pools vary greatly in size, amount of food present and perhaps most importantly, chemical composition. Similar-sized fish in the New York Aquarium have about tripled their length in three years. In 1933 small tarpon collected on Andros Island[1] showed indications of having been stunted in similar land-locked locations, but now we have actual records of individual tarpon showing no growth whatever for periods of more than six months in localities of such a nature.

In any event, it is now clear that these pools cannot contribute importantly to the support of the large, adult tarpon population. There are



A typical tarpon—one of the greatest game fish of the world. This individual now resides in the tanks at the New York Aquarium, having come up north about three years ago as a very little fishlet. Since then it has approximately tripled in size and is still growing.

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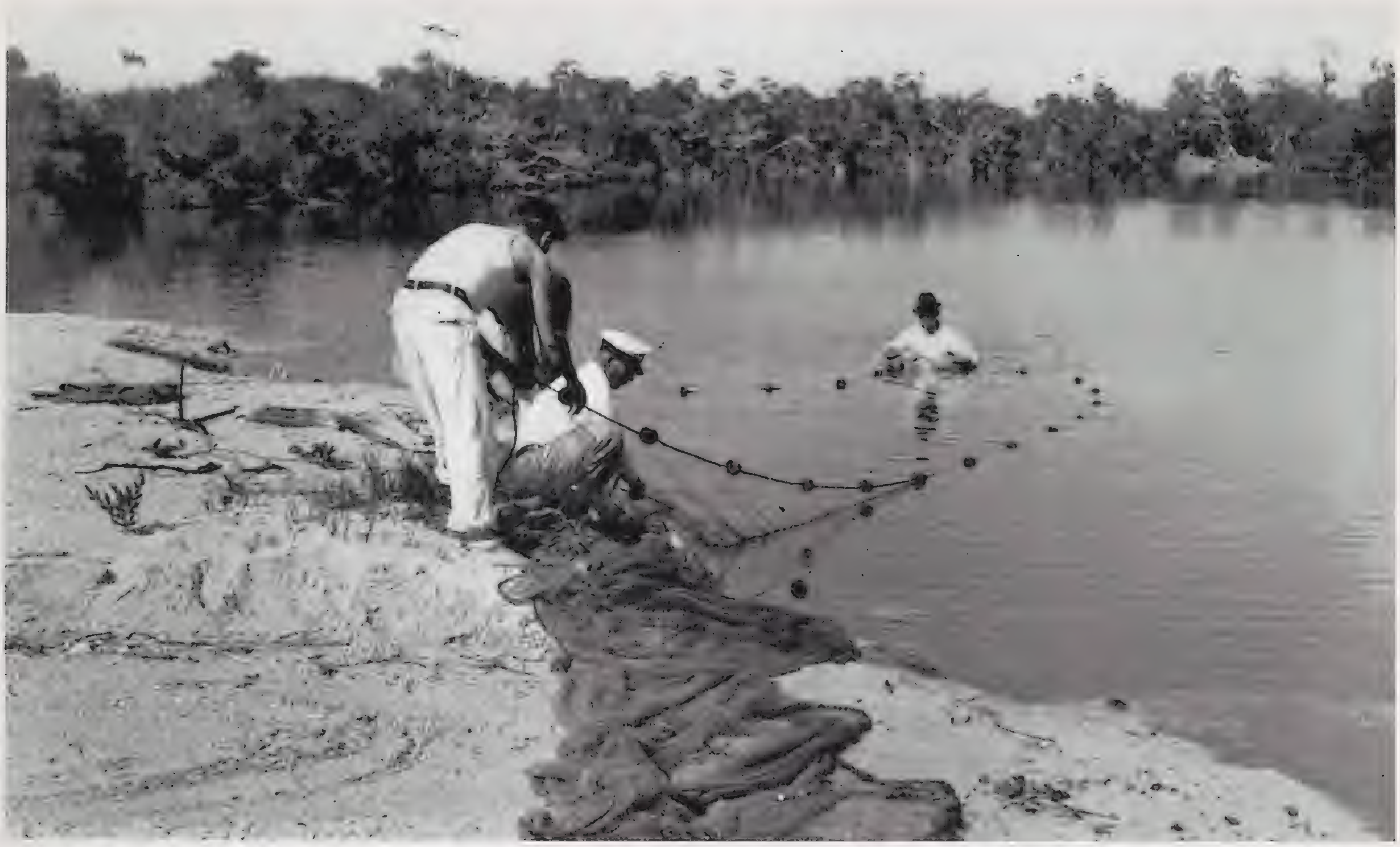
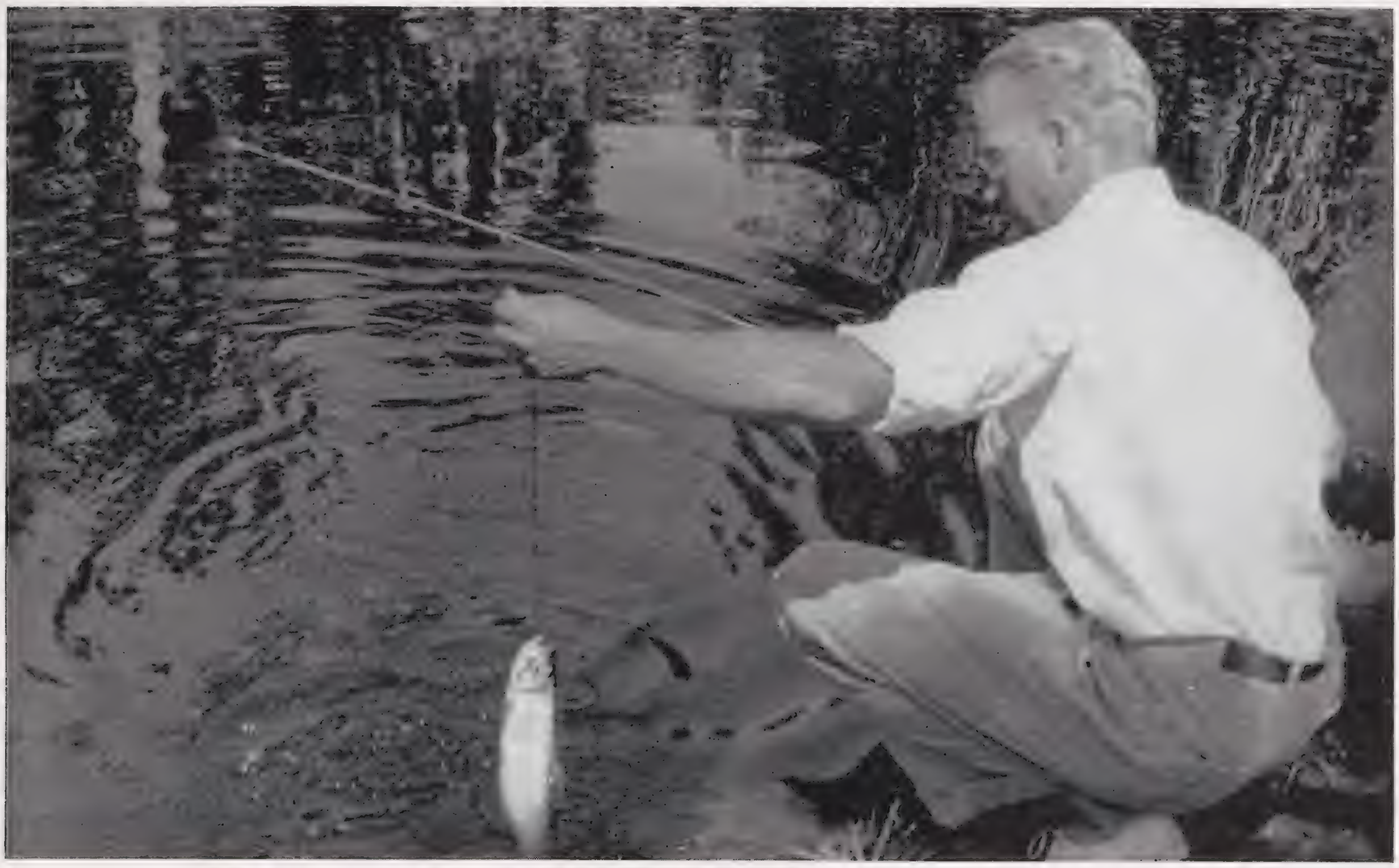
[1] Breder, C. M., Jr. Young tarpon on Andros Island. *Bull. N. Y. Zool. Soc.* **36** (3) : 65-67.



One method of catching tarpon was to use a gill net. Tarpon readily jump over and out of the ordinary seine, and sometimes they simply punched holes in it and escaped. The slender strands of the gill net, with its greater amount of "give," successfully entangled them.



Another practical way of taking the little tarpon was to angle for them with light gear. In this picture Mr. Bishop has just landed one in an inland pool and is bringing it to the bank for tagging, after which it will be returned to the pool or the open sea.

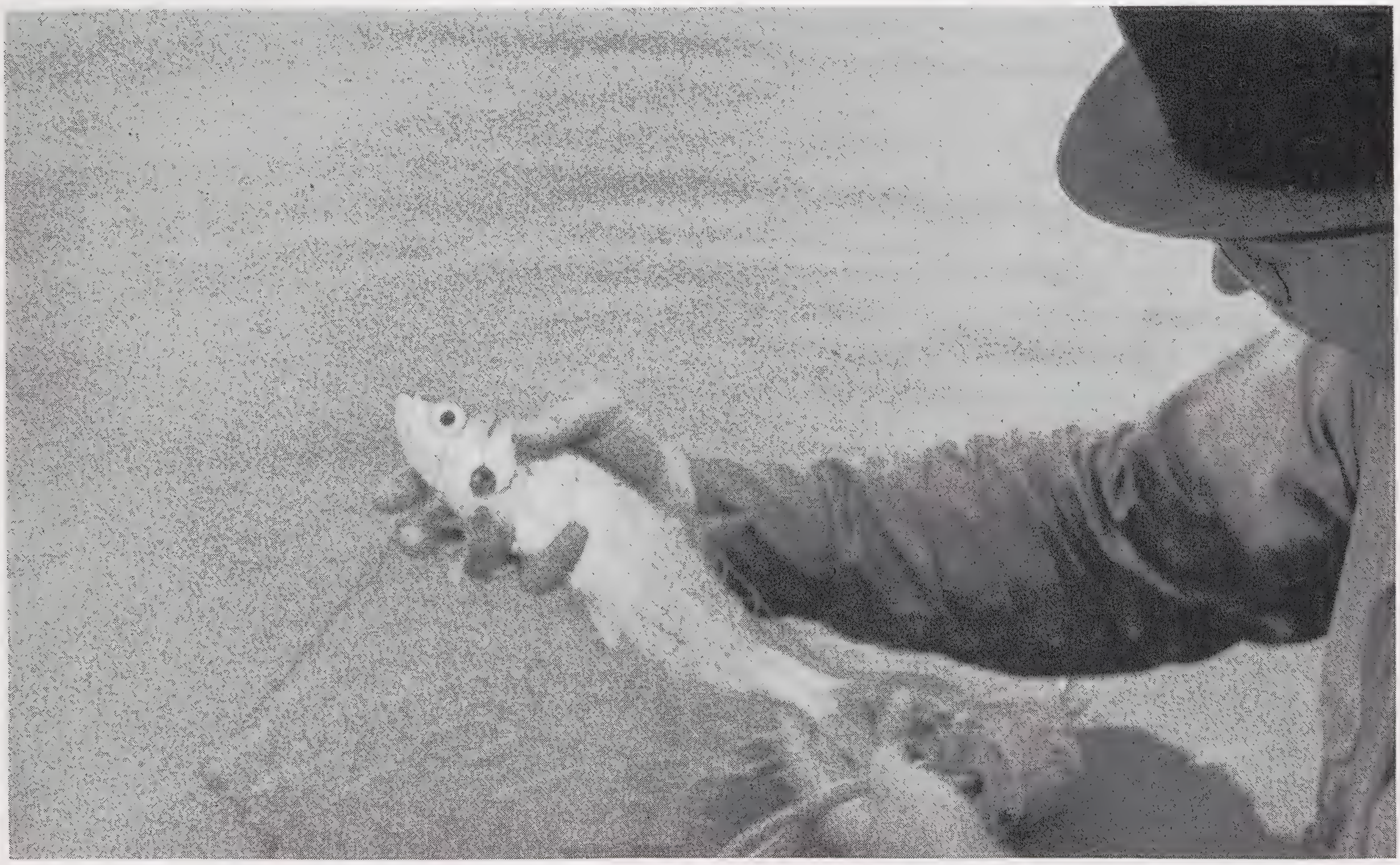
After the fish is caught, it is quickly measured, tagged and released. This view shows Mr. Bishop in the act of tagging a tarpon he has just landed, while Mrs. Bishop records the number of the tag, the size of the fish, and similar data for the laboratory records.

A close-up of the actual tagging operation. In skillful hands it takes only a moment to clamp the tag onto the gill-cover. In this instance, before the film could be changed in the camera that was recording the operation, the fish had been tagged and was back in the water.

not enough of them nor are they sufficiently well populated to be real tarpon nurseries. The question of how the fish get in or out of these places has been subject to much controversy. It would seem that many methods contribute to their entry, high water and hurricanes presumably being the most important. If true, this must mean that young tarpon are fairly numerous close to shore during the stormy season, the fall of the year. For obvious reasons, this season is little known to collectors and is in need of study.

How they get out, if they do normally, would be by the identical means of entry. Since we know that some of these pools are not connected to the sea for years at a time, in some cases, the stunting already alluded to is readily understood. Pools which have an evident connection with open waters are almost always devoid of small tarpon, indicating that they do not long remain voluntarily in such places. This latter type of pool is usually of better water because of its connection with the sea, and is apt to contain other varieties of fish which run in and out with the tides. The land-locked pools in which the tarpon are customarily found are, on the other hand, usually without other species of fish. In fact, these places are frequently so foul that other fishes could not survive in them long. Ordinarily the tarpon is thought of as a fish that seeks clear, pure sea water, but this species is quite capable of living in fresh water and even in abominable troughs of sulphur-smelling, soupy holes.

Strangely, for a fish of this type, it is able to survive such places by virtue of its ability to breathe atmospheric air. Although provided with what appear to be well-developed gills, it nevertheless habitually swims to the surface to breathe, whether in water that demands recourse to this auxilliary respiratory device or in water adequately aerated for any ordinary fish. As any tarpon angler will testify, the tarpon is no ordinary fellow, and being provided with a functional lung as well as the usual fish gills, is, so far as respiratory needs go, considerably superior to its environment. A considerable amount of the "rolling" of tarpon (that is, breaking water) is accounted for by this habit of rising to the surface for air.



This is a re-captured tarpon, just as it was being taken from the net. The tag shows as a dark circle on its gill-cover. This tarpon had been tagged by the laboratory about six months before; its tag number is a reference to records of its size on the date of tagging.

In some places the shore line prevented the catch being beached, and it was necessary to close in the seine when well off-shore.

Here the seine has been drawn close and specimens of various kinds of fish are being collected for live shipment to the Aquarium.

A bottom dredge going overboard to pick up, in a small silk net, eggs stirred up from the bottom. Some may be the eggs of tarpon.

In slack moments at the laboratory, Mrs. Bishop worked on a cast net—a very useful device for taking many of the small fishes.

Eggs which, it was hoped, could be fertilized and studied were removed from fishermen's catches of tarpon at the lighthouse dock.

A temporary laboratory was set up on the dock at Boca Grande Pass to give the newly-taken eggs a quick preliminary examination.

The 161 fish placed in the sea were the only ones from which regular returns could be expected and to date they have yielded thirteen returns. The distances traveled have not been extraordinary—the greatest being about sixteen miles from the point of origin.

There is evidently considerable tendency in the tarpon to move upstream, which is, of course, in keeping with general observations. The time is yet too soon to expect these fish to travel any great distance, if in fact they do, or to appear in the general tarpon anglers' catches which are geared chiefly for really large fish. Of ten anglers'-sized fish tagged, a single return has been received. This fish moved from Boca Grande Pass to well up into the Myakka River, a distance of some 20 miles, between July 7 and September 17, 1938. Tagging experiments by their very nature are basically longtime operations, and one cannot expect rapid results.

Since the eggs, their development and that of the larval tarpon are not known, the pursuit of this particular item of life history has occupied a considerable amount of attention.

There are two chief methods of approach to this problem in the study of sea fishes. One is to catch eggs in a fine silk net towed in places where guessing would place them, and then by a process of elimination of the various kinds found, eventually to locate the species under consideration. The other is to capture mature fish ready to spawn, obtain eggs from them and fertilize them, letting them hatch in the laboratory and studying their development. This method has the advantage of being certain as to species from the start.

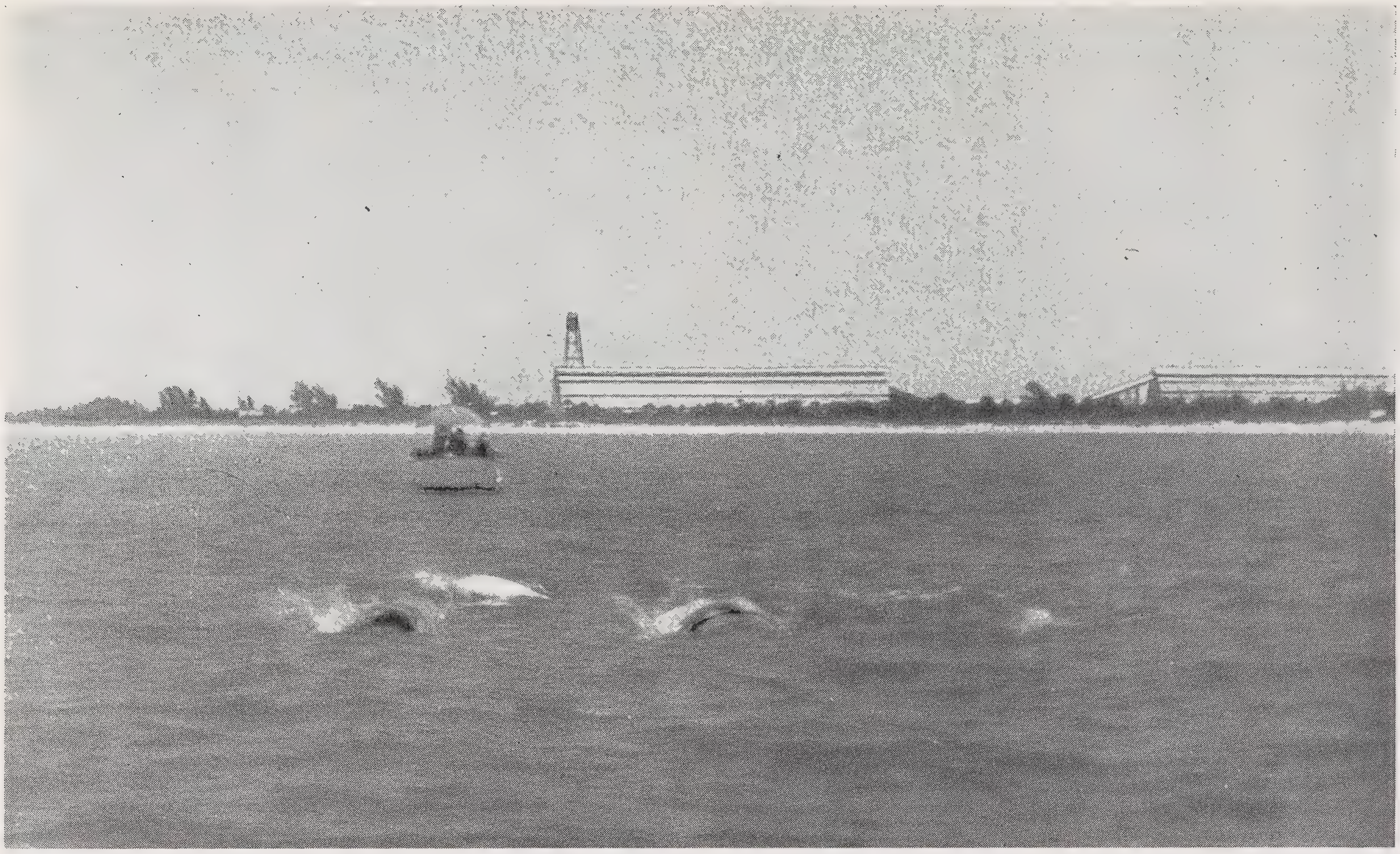
Both of these methods are being tried. The latter is sometimes easy and sometimes difficult, depending on one's skill and luck in obtaining fishes in just the proper condition. Males were easy to obtain this spring with milt running from them. In this connection they differed from other species with which the writer has worked, chiefly in the quantity and viscosity of the milt, a feature often noted by anglers.

Females nearly ripe were common enough, but none could be had that was just ready to spawn. A single large fish was obtained which, in its struggles, emitted a few eggs. We thought for the time we had what we needed, for in most fishes this condition is met with only when the eggs are in a fertilizable state, but the eggs were not quite ready for use. However, all the efforts were not wasted, for besides learning that these fish may pass eggs, under strain, which are not quite ripe, we were enabled to work out various details that are valuable in connection with the progress of this work. Without going into the technical details, we now have good reason to believe that the fully mature eggs sink rapidly in sea water, and we have been able to determine within narrow limits the actual size of the mature, fertilized and water-hardened egg. On a basis of the relationships of this fish and the appearance of the ovaries, most people had looked for floating eggs, although Mr. L. L. Babcock long ago realized the possibility of their sinking. It is thus not surprising that tow nets drawn close to the surface have yielded nothing that anyone has been able to designate as tarpon eggs.

Furthermore, these eggs are non-adhesive, a feature not common in heavy, sinking eggs. These considerations and facts led us to undertake bottom towing more seriously. Of the few eggs that can be taken by this means, only one kind showed characteristics that made it impossible to eliminate them from consideration. These eggs were carried on in the laboratory and hatched. The resulting larvae, of extreme delicacy, survived a short time and are now under study in an effort to place them definitely as either tarpon or not tarpon. It may be mentioned that very young fishes, in the absence of any intermediate stages up to fully recognizable fish, are frequently very difficult to identify with certainty.

Since so few of these eggs were taken and all of the females examined contained eggs, it would seem that the height of the spawning season had not been reached. This is in keeping with anglers' lore, but unfortunately, because of other demands, it was impossible, and for certain practical field conditions unwise for us to pursue the matter further this summer. It is planned, in the light of the knowledge collected this year, to approach the study next season, a little later and in a different manner.

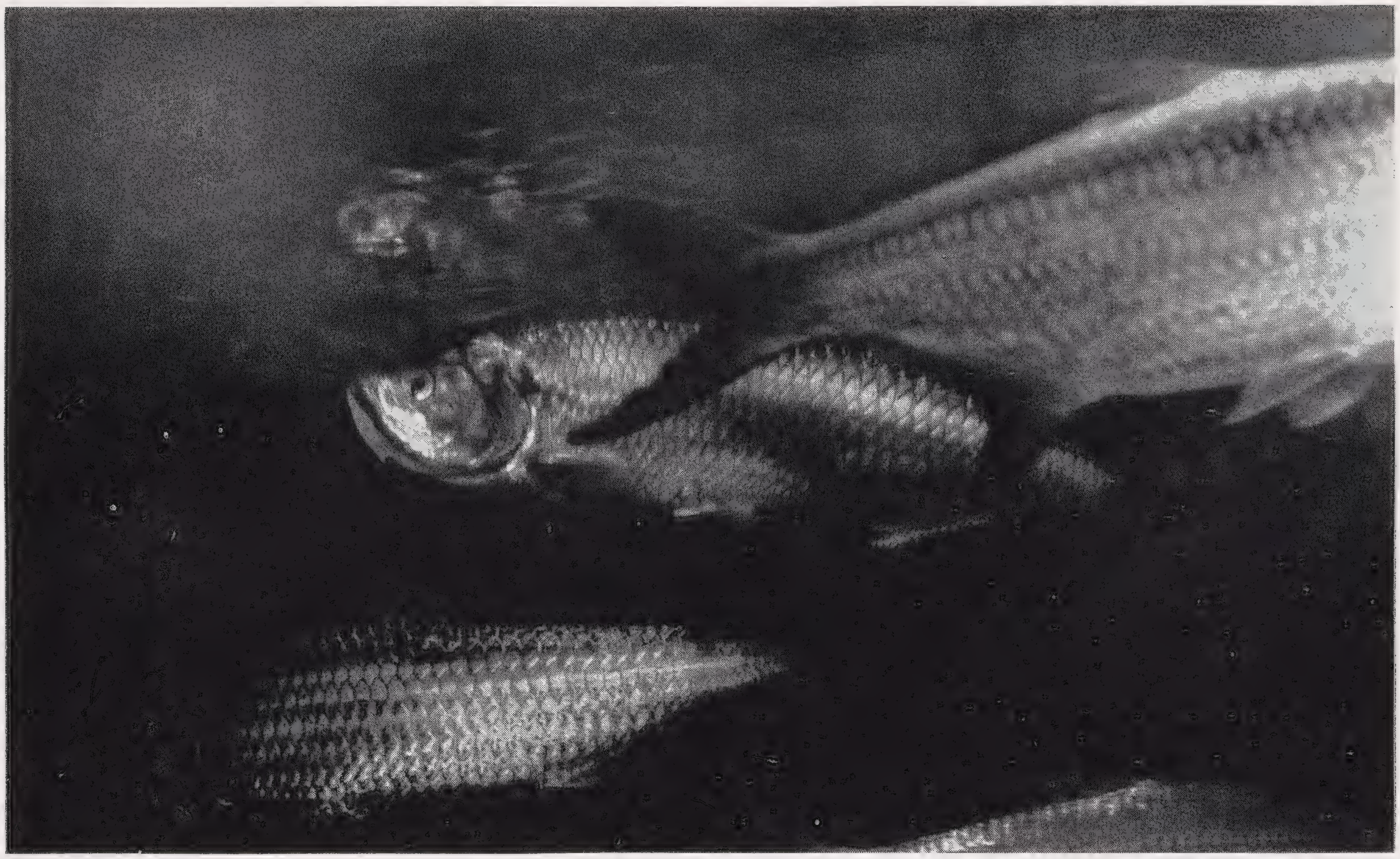
Another possible interpretation of the situation we would not have been aware of without this season's work. Since it is well known that

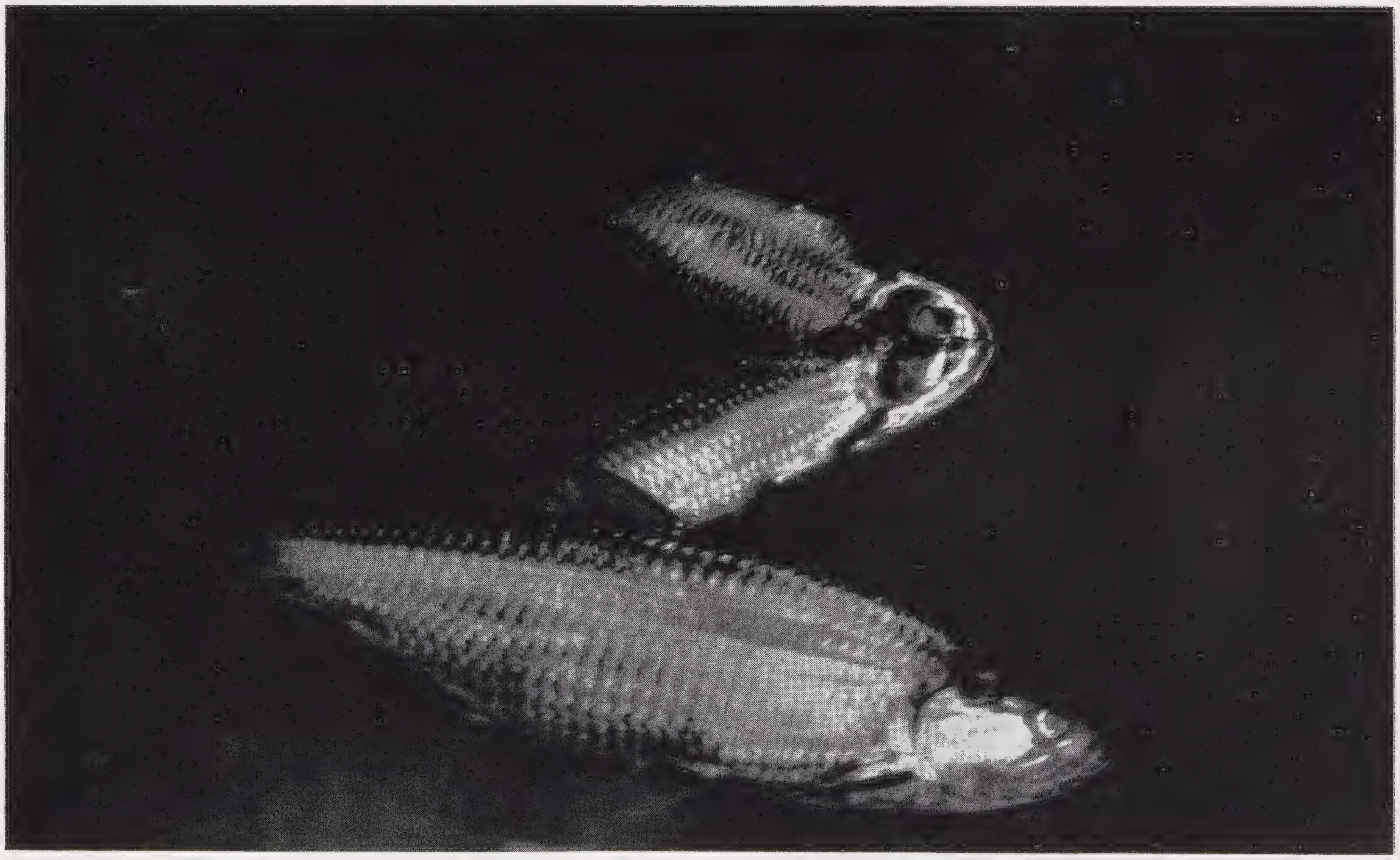


Here in the Boca Grande Pass tarpon are "rolling" as they come to the surface to breathe. Tarpon are provided with a functional lung as well as the usual fish gills—a fact that is very useful to young specimens that may be penned up in swampy, fetid, landlocked pools.

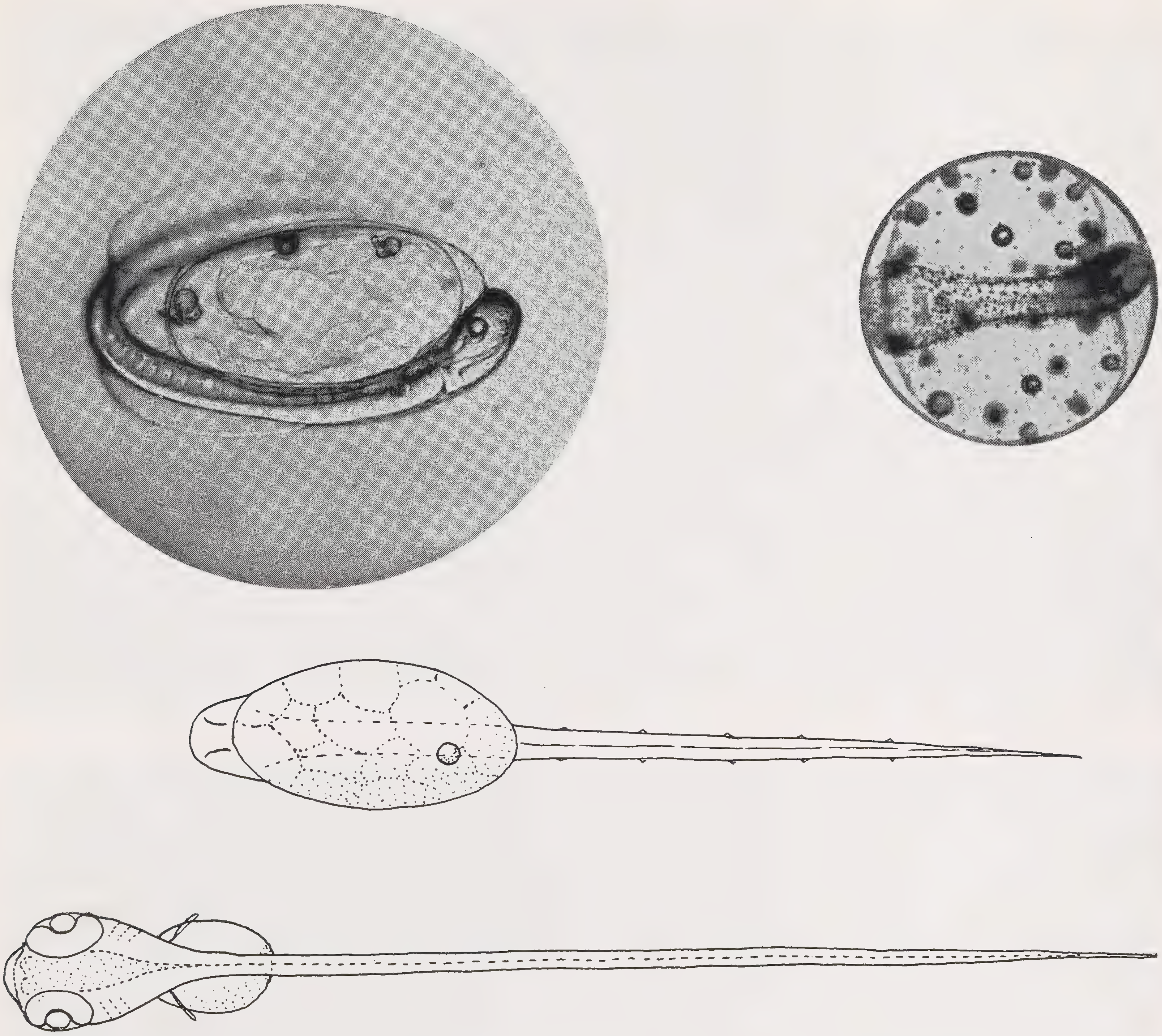
many fishes will not feed during their spawning season and consequently are not available to anglers, a pretty problem arises. Tarpon angling is at its height when the spawning season is apparently on and the sportsmen do catch fish so full of roe that it sometimes drips from them. This has led to a belief that tarpon go on feeding throughout their spawning activity. We have seen, however, that sometimes captured females may shed spawn which is not yet ready for fertilization. There is thus the possibility that individual females may cease feeding when the roe becomes ripe and spawning is imminent. Since, obviously, all the fish do not become ripe simultaneously, this could not be detected readily by angling, for one would be continually catching those individuals which were not quite ripe until the spent fish began appearing in the catches. This thought suggests the need of taking some tarpon by non-angling methods where the vagaries of their appetites in response to physiological condition play no part. An alternative would be to capture nearly ripe fish by angling methods and to hold them in a large enclosure until their eggs become ready for use. Our next step will probably be to employ both of these methods another season.

Another item of mystery concerning the tarpon is the whereabouts of very small specimens. The species, on a basis of relationship, should pass through a peculiar and specialized stage of development known technically as a leptocephalus. One such individual was taken off the coast of North Carolina by Dr. S. F. Hildebrand of the U. S. Bureau of Fisheries some years ago, but was accidentally destroyed before it could be either figured or adequately described. This specimen, which was undoubtedly referable to this species and was identified as such by Dr. Hildebrand, was the only known specimen of the larval tarpon. Since surface tow netting was undertaken by Mr. Bishop all last summer and this spring, both day and night, without finding leptocephali, we can be reasonably certain that they do not come to the surface layers. In view of what we now know of the eggs of the tarpon, it may well be that the leptocephalus larvae hug the bottom closely and work their way inland in this one environment in which adequate collections have





These two pictures are "fish's eye" views of tarpon in the act of "rolling." Both pictures were taken in the Aquarium, from below the surface of the water. In the top picture, one fish is just ready to break the water and his reflection on the surface can be seen; in the lower view the fish has actually broken the surface in the beginning of his "roll," and the reflection of his body is plain. These are the first pictures of the kind that have been taken.



These pictures tell briefly the progress of the tarpon study. The photographs show 2 kinds of non-adhesive eggs found on the bottom; the larger one may be that of the tarpon. Below are camera-lucida drawings of the larvae hatched from the larger eggs, the smaller one just after hatching and the larger twenty-four hours later. The larger egg is not quite 2 mm. in diameter. Some of these, in a preserved condition, are now under study.

not been made. Later at a considerable size of three or more inches, the young tarpon become evident in numbers in such places as the Peace and Myakka Rivers, and, according to many accounts, in truly prodigious quantities about the Ten Thousand Islands.

The accomplishments so far at the Florida Tarpon Station encourage us to believe that we are beginning to throw light on a hitherto secret part of tarpon life history. Only a beginning has been made, but the lines of investigation are marked out for the future, and in the meantime our tagged tarpon move on to their eventual destination—charted record of their journeys.

The Tarpon Station has many other interests to pursue, and a large collection of other fishes of the region has been "farmed out" to various specialists who are working on reports of this interesting and poorly-known area. Some excellent motion and still pictures have been made—some of the latter contributing to the illustrative material about the "Mangrove Habitat Group" at the Society's World's Fair building. All of the pictures illustrating this article are, unless otherwise credited, the work of Mr. S. C. Dunton of the Aquarium staff.

The Living Jewels Called "Hummingbirds"

Audubon Thought of Them as "Glittering Fragments of the Rainbow," and Descriptions Vie in Superlatives

Lee S. Crandall

IT is not easy to write calmly about Hummingbirds. The impulse to burst forth in superlatives is almost irresistible. In fact, it would be entirely so if it were not for the quieting realization that too many skillful writers have already yielded to the urge. "Gems of the feathered world" was the phrase used by Knowlton to introduce the section devoted to Hummingbirds in his "Birds of the World." Earlier, Audubon conjured up "glittering fragments of the rainbow." Newton says that the metallic green of the general plumage of most species is "overpowered by the almost dazzling splendour that radiates from the spots where Nature's lapidary has set her jewels." Since we cannot hope to better these phrases, we shall evade the challenge and try to write of Hummingbirds as though they were creatures of the ordinary world. If a superlative should slip in here and there, we shall try to ignore it.

The amazing beauty which has aroused such enthusiasm is not the Hummingbirds' only point of interest. Their diminutive size, the invisible beat of buzzing wings and their curious method of feeding, all have special fascinations. The tiny bodies and intensely specialized feeding habits of the Hummingbirds give the impression of creatures poorly equipped for possessing a niche in the scale of life. This thought, however, is immediately refuted by the realization that there are more than 650 kinds, found in the Americas from Alaska to Tierra del Fuego, with a concentration in the northern Andes. Only organisms that are highly successful, perfectly tuned to their environment, can produce such extensive variation. Wherever there are flowers, Hummingbirds are at home, whether in steaming lowland jungles or just below the line of perpetual snow in the towering Andes. Now we see the Hummingbirds in a new light: intense, vital, indomitable, succeeding almost beyond their right, because of a specialization which, in other directions, has brought many greater races to extinction. They are making niches in the scale of life, not merely holding them. They will be triumphant until the world of plants finds other means than flowers for its own propagation.

With an array of forms so extensive we cannot attempt here more than a general account. In his great Monograph of the Trochilidae, or Hummingbirds, completed in 1861, John Gould devoted five volumes in imperial folio to the kinds then known to him. A glance through the magnificent colored plates that adorn this work leaves one gasping with amazement that so much beauty can be displayed by such tiny bodies. In addition to scintillating colors, almost every form of feather decoration known in birds is to be found—weird crests, throats bearing frills and ruffs, elongated tails sometimes carrying rackets at their tips, pigmy thighs adorned with powder puffs of purest white.

Colors alone have caused describers trouble enough. So intense, indeed, are the blazing facets of the tiny feathers that bestowers of English names have been hard pressed to find fitting titles. Emerald, topaz, garnet, sapphire and ruby have been called from the list of precious stones to do duty for the birds that rival them in beauty. But when to these difficulties are added those of fantastic ornamentation, words are strained to the utmost. Heavenly phenomena have been invoked, as in the Hill Stars, the Star-frontlets, the Star-throats and the Wood Stars; also the Sun Angels, the Sunbeams, the

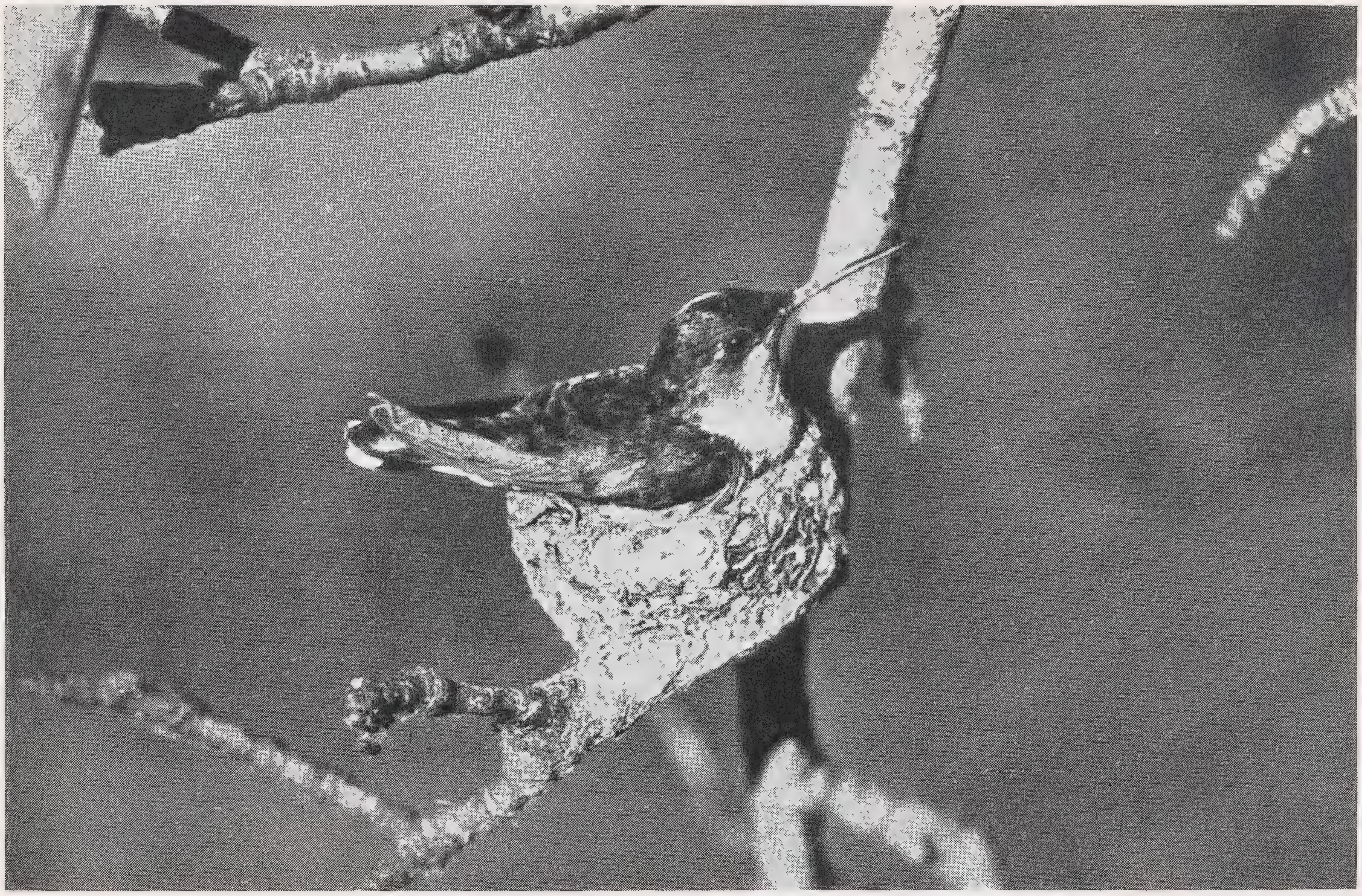


Photo by C. W. Leister

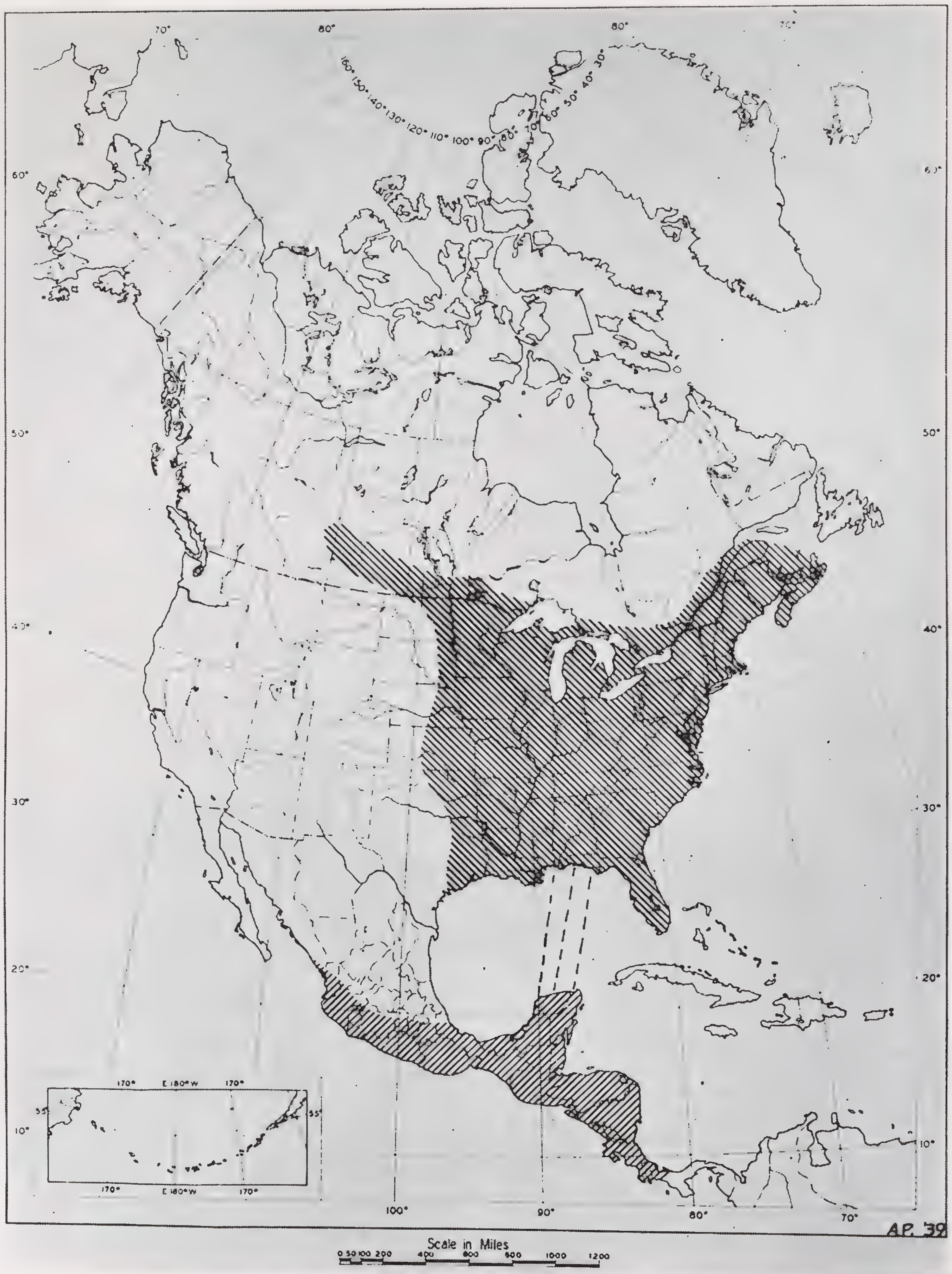
Tiny as the Ruby-throated Hummingbird is, its nest is even tinier and a large proportion of the bird extends over the sides. In such nests, constructed of plant down and covered on the outside with lichens, the Hummingbird incubates its two small, ovoid, white eggs.

Rainbows and the Comets. Mythological beings are represented by the Sylphs, the Fairies and the Wood Nymphs. Drawn from other spheres are the Coquettes, the Train Bearers, the Puff-legs and the Racket-tails. Opposed to the sublime are the Hairy Hermit and the Bearded Mountaineer, although some reactionaries may refer to the latter as the Mountain Nymph.

All of the Hummingbirds are small, the greatest being the Giant Hummingbird (*Patagona gigas*), with an over-all length of 8½ inches. Two forms are recognized, both found in the Andes, from Ecuador to Chile. The smallest member of the family—and therefore the smallest bird known — is Princess Helena's Hummingbird (*Calypte helenae*), of Cuba, which measures only 2⅜ inches. This mite enjoys the further distinction of extreme beauty, for it is metallic blue above and white below, while the head and pointed gorget are bright rose pink. Few actual weights of Hummingbirds seem to have been recorded, but two specimens of our native Ruby-throat, weighed by Doctor Charles R. Schroeder, balanced at 1.9 and 2.29 respectively, in grams. On the same scales, a copper cent weighed 3.5 grams. It is almost inconceivable that a body capable of producing such tireless energy should be so tiny.

All things considered, it appears that the flight of the Hummingbird is its most fascinating character. In nature, the bird usually is seen for a breath-taking instant, then is gone, leaving only an impression of humming, unseen wings. There is no time to note glowing colors, fantastic decorations. Sometimes, indeed, we may have seen a Hawk Moth, whose flickering wings and extended proboscis give a close simulation of a Hummingbird in flight. People who have seen numbers of "baby Hummingbirds" seeking nectar in their gardens are often hard to convince that they have been misled.

We have always known that the beat of the Hummingbird's wing must be very swift but until recent development of high speed motion picture cameras permitted photography of the birds in flight, there was no means for measure-



The shaded area in the eastern United States and Canada shows the breeding range of our familiar Ruby-throated Hummingbird, and the shaded area in Mexico and Central America represents its wintering territory. On the bird's migration it makes the 500-mile jump across the Gulf of Mexico represented by the dotted lines. This map was prepared for the Bird Department by Frederick C. Lincoln of the Bureau of Biological Survey.

ment. Such pictures, made by the Massachusetts Institute of Technology and by the Reichsstelle für den Unterrichtsfilm, showed the beat, at least in some species, to be at the rate of approximately sixty up and down movements per second. In the German films, shown at the meeting of the Zoological Society in January, 1939, through the courtesy of Dr. Werner Rüppell, a remarkable fact was demonstrated: on each downward or backward stroke, the wing turns completely over, so that it is actually upside down.

It is evident that such speed requires great expenditure of muscular energy, demanding constant supplies of quickly assimilable food. A controversy of considerable proportions arose recently, occasioned by a statement from this department that captive Hummingbirds feed, during daylight hours, at least once in ten minutes. This is approximately true, as anyone with a little time to spare, and birds to watch, can readily demonstrate. The difficulty arises in explaining how migrating Hummers such as the Ruby-throat, which annually crosses the Gulf of Mexico, over 500 miles of open water, are able to store sufficient energy for the trip. Indignant protestants overlook the facts that captive birds are fed an artificial diet, which may be somewhat deficient, and are likely to be of tropical species which do not make long migration flights. Quibbling aside, it seems impossible that a bird weighing much less than a cent could accomplish such a feat. But there is no doubt that it does!

Ricord's Emerald, from Cuba, was the first species kept successfully on artificial food. One of ours lived 3 years, 4 months.

The matter of the food of Hummingbirds is one of great consequence, particularly in attempting to keep them in captivity. The tongue is a tubular affair, so extensile that it is able to enter flowers and secure their nectar and the tiny insects that are harbored there. Many species also hawk for insects in the air, or search for them on the surfaces of leaves. Early writers supposed that nectar was the only food, while later authors, basing their opinions on actual analyses of stomach contents, usually consider that the diet consists mostly of insects. Until very recent years, these schools of thought agreed that the problem of food would always prevent the keeping of Hummingbirds in captivity.

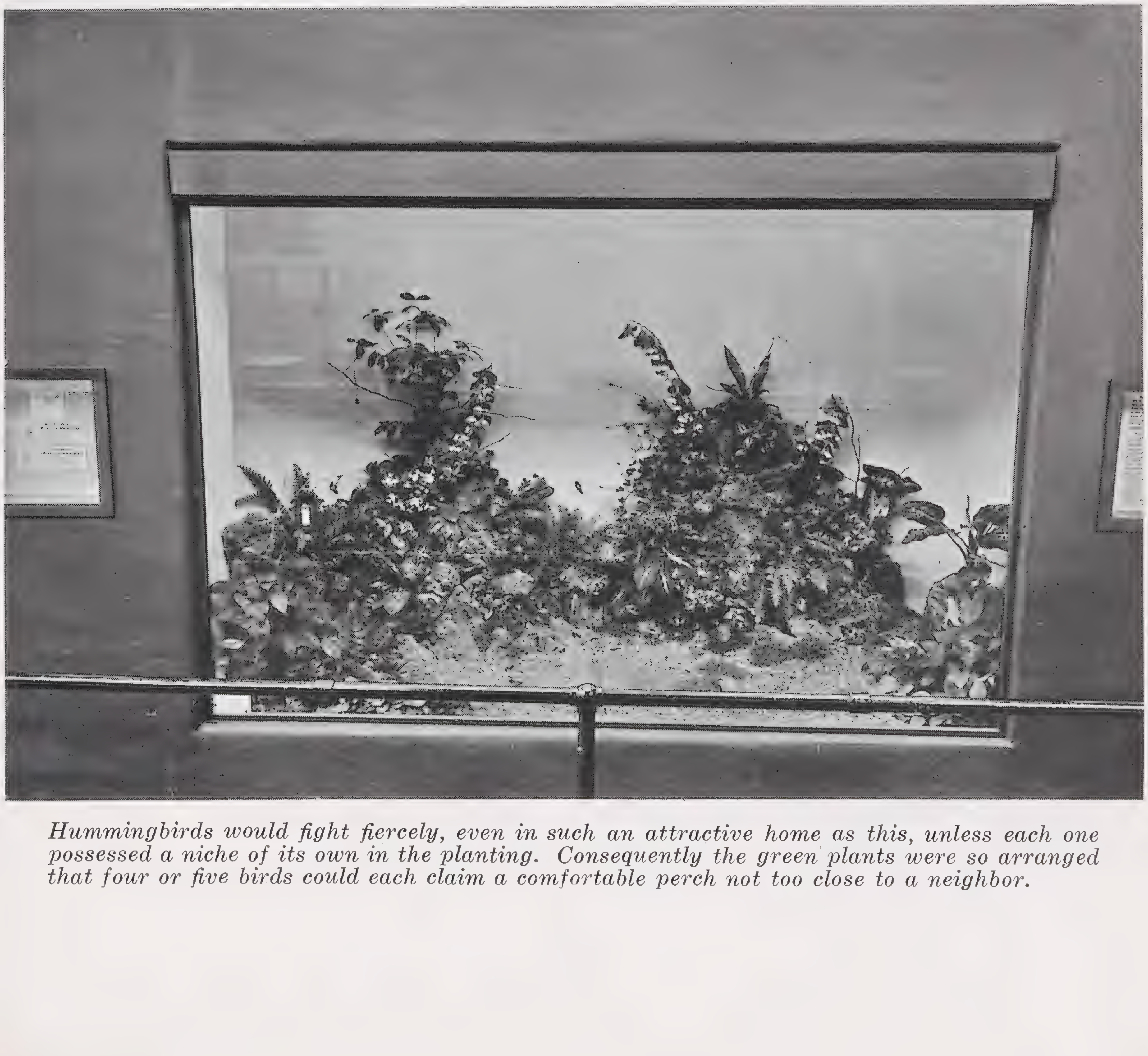
This opinion, indeed, was well borne out by early experiences. The literature of the subject contains many accounts of attempts to keep Hummingbirds alive long enough to have them reach Europe. Mostly they resulted in failure. In 1857, however, the great John Gould succeeded in landing a specimen of our Ruby-throat in London, where it lived for two or three days. This was a remarkable feat, since transatlantic travel was slow and the necessary food was but little understood. No doubt other and better records than this were established later but the modern treatment of Hummingbirds in captivity begins with the arrival at the Zoological Gardens of London, on November 25, 1905, of a living specimen of the Bolivian Violet-eared Hummingbird, the first to be received at that great institution. This bird was transported by no less a person than Major A. Pam (then Captain), whose avicultural feats are many and who now is Treasurer of the Zoological Society of London. This first arrival lived for only two weeks but served to renew the hope that these almost fabulous birds might eventually be maintained so that all could admire their beauty.

In 1908, Major Pam landed another shipment, this time from Venezuela, but of the eighteen birds included, only one managed to survive for five weeks. It was not until our good friend Mr. Alfred Ezra, now delightfully domiciled in Surrey, England, secured a specimen of Ricord's Emerald Hummingbird, that real progress was made. One of the world's most devoted and skillful aviculturists, Mr. Ezra devised the epoch-making mixture of Mellen's Food, condensed milk and honey, that proved to be the open sesame to the world of Hummingbirds. Mr. Ezra kept his bird for more than two years, a feat that aroused the greatest avicultural enthusiasm. It was obvious that the birds could now be kept, if they could be had. In 1914, the late Marquess de Ségur voyaged to the Antilles and brought back fourteen Hummers, maintained in perfect health. In 1922, Mr. Jean Delacour visited the Guianas and brought back twenty-one.

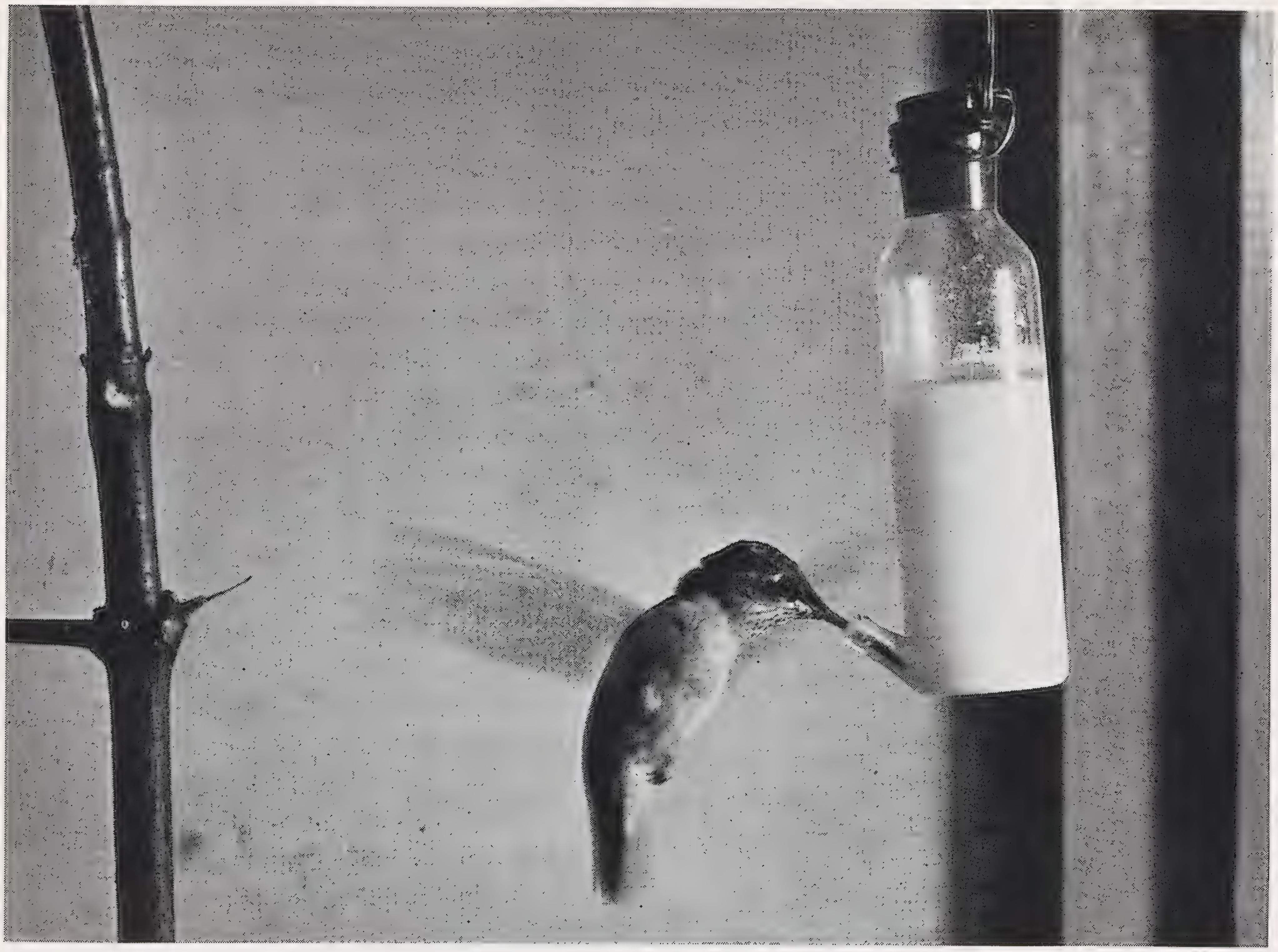
By this time, Hummingbirds had become as commonplace as such delightful creatures could, at least in the hands of experienced men. But there remained still another step, in which M. Delacour had the lead. This was the devising of aviaries of the greenhouse type, in which temperature and humidity could be more or less controlled, and where the birds could be kept almost at liberty. The successful installation of such an aviary on M. Delacour's lovely estate in Normandy set a vogue which was quickly followed by most of the Zoological Gardens of Europe, particularly London, Berlin and numerous other German institutions. Considerable numbers of Hummingbirds arrived, under the care of skillful collectors.

In America, progress has been slower. Scattered early experiences with Ruby-throats had convinced us that we were not yet sufficiently advanced to keep them successfully. But news of Mr. Ezra's discovery had reached us and when, in 1928, two specimens of Ricord's Emerald were obtained, we eagerly grasped the opportunity to put the new diet to the test. Curiously, the species was the same as that of Mr. Ezra's original bird and his formula worked as well for our birds as for his. One lived two years, the other three years and four months, a period that stood for long as a maximum record and might have been extended but for a defective electric heating coil in the cage.

Since that time, we have usually exhibited Hummingbirds of one species or another. We kept them singly in glass cases about two feet in each dimension, well ventilated and heated by electric devices, though without accurate thermostatic control. Always we thought of a cage built after Jean Delacour's greenhouse plan but always we hesitated. Hummingbirds are notoriously quarrelsome and at close quarters will fight like fiends. We could not risk a failure and this seemed a likelihood until the



Hummingbirds would fight fiercely, even in such an attractive home as this, unless each one possessed a niche of its own in the planting. Consequently the green plants were so arranged that four or five birds could each claim a comfortable perch not too close to a neighbor.



Motionless in the air except for the almost invisible beating of its wings, the Ruby-throated Hummingbird hovers in front of a small glass bottle containing the special Hummer diet of Mellen's Food, condensed milk and honey. In captivity Hummers feed about every ten minutes.

problem of maintaining a friendly and contented group was solved.

When the trip to the Ornithological Congress at Rouen was projected last year, the question of Hummingbird exhibition was one of the problems on which information was to be sought. Inspection of the installations at London Zoo and on the estates of M. Delacour and Mr. Ezra, as well as conversations with many experts, brought the answer. Of many species, more than one specimen cannot be kept in the same enclosure under any circumstances; birds of some of the less aggressive kinds will live together in thickly planted cages, where each has a well defined clear space to himself; there may still be a small fringe of species that may prove more tolerant. All of the European installations seen last year were operating on one of the first two principles.

It seemed, then, that we had been well advised to wait, for if we could manage a unit which could be so planted as to afford individual niches, and still not be too thick to allow the birds to be seen, we might hope for success. As our plans approached fruition and seemed ready to be put into effect when the necessary money became available, Mrs. John D. Rockefeller offered to build the cage as a gift to the Zoological Society. The services of Mr. Harold Sterner were secured for designing the cage and under his supervision, construction by our own force was begun on March 21, 1939. The work of renewing the roof of the Bird House and completing various improvements of the interior, as reported in the last number of the *Bulletin,* was still under way, so that the slight added confusion was hardly noticed.

The west end of the Middle Cage, in the Main Hall of the Bird House, was chosen as the most suitable site. A curving shell of reinforced concrete, with inside facing of Keene cement, and lighted by a sheet of plate glass measuring 8′ 10″ x 6′ 4″, gave us an interior space 4′ 6″ x 11′ x 8′. This was painted a lovely soft blue, which was reflected in a small pool of similar color, furnished with a miniature fountain. Low rock-work of tuff stone was then arranged against the walls by Head Gardener Skene, and set with small living plants. Niches were successfully obtained, for the benefit of the birds, the complete effect being a great credit to Mr. Skene's artistic ability.

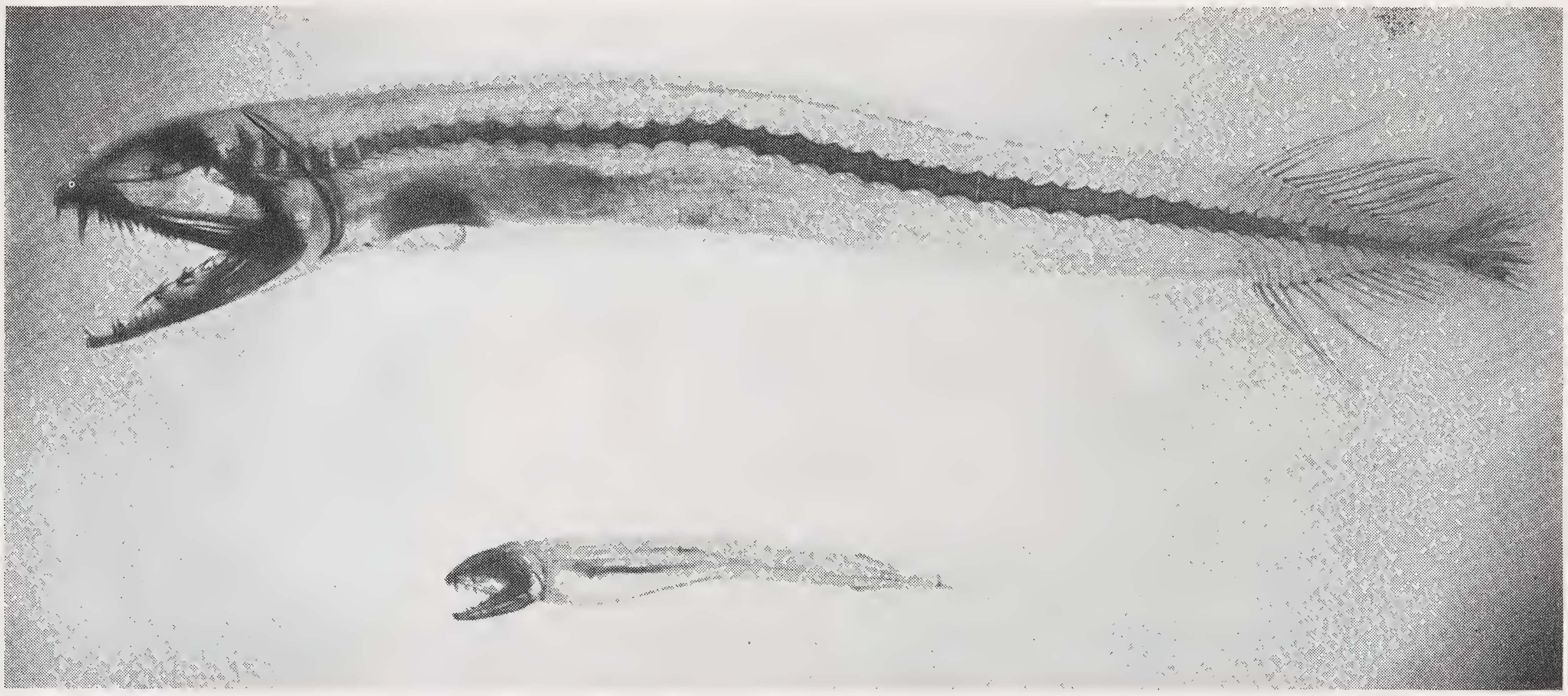
We were able, by some means or another, to take advantage of every modern development in cage construction known to us. The enclosure is practically free from outside atmospheric influence, and although an abundance of sunlight enters through the glass, artificial illumination has been provided. Ventilation is controlled by an exhaust fan, which draws air through small, adjustable openings near the floor. Heat is provided by means of thermostatically operated electric coils set in the fresh air ducts, installed in duplicate on chance of failure by one. A fine jet fills the air with "artificial rain," as used in London Zoo, so that the desired high degree of humidity may be maintained, the surplus water draining off through the coarse gravel used to cover the exposed portions of the floor.

In planning our program for Members' Day at the Zoological Park, which fell this year on May 18, the "dedication" of the Hummingbird Cage was made one of the main features. Long before this date, of course, we had been sending out feelers for Hummingbirds. We did not want them too soon, but we had to have them by May 18. The Hummingbird supply is not so well assured in America as it is in Europe. One by one our sources failed and it began to appear that we were in serious trouble. Nearer grew the date and more distant seemed our Hummers. You just cannot dedicate a Hummingbird Cage with no Hummingbirds! Then, just before the deadline, a desperate appeal to a local dealer bore fruit. He cabled to his collector, about to sail from Venezuela, and almost exactly on schedule he appeared, quite calmly, with a small lot of Hummers. Happily we learned that they had been fed on honey, instead of sugar, diluted with water. Hummers fed on sugar will not give it up and presently lose their lives—as early attempts at importation proved. We selected four lovely little Caribbean Emeralds and a larger, gorgeous Black-throated Mango. The birds were ready.

Not so, however, with our new cage. If the work of two months had been carefully planned and plotted, it could never have been made to come out as it did. When the officers of the Society and expectant members arrived before the cage on the afternoon of May 18, we were still trying to coax four fluorescent daylight lamps into lighting it. There was an embarrassing five minutes when nothing happened, but then the birds went in and more then compensated. The simulation of daylight by the tubes made the little creatures gleam like the jewels they really are and stimulated them to an excess of frantic energy. They darted about, as fast as light itself, exploring every cranny. They found the pool and first darted through the spray, then dipped their tails with caution and finally plunged into the half-inch depths with abandon, soaking themselves again and again. The dedication was a success.

After more than two months, the whole project seems to be working well. We have learned enough now, it seems, to make adjustments if they should seem necessary. Two days after the birds were installed, the Mango proved too strong and too aggressive for the little Emeralds, and had to be removed to an ordinary flight cage, where he can hold sway over Sugarbirds and Callistes without endangering their lives. The four Emeralds, quarrelsome at first, have now settled down so well that already we are wondering if we might not be able to introduce one or two more — quite small ones of course, if we had them! All day long they test the small glass tubes that hold their liquid food, snap introduced fruit flies in the air or lick them from the foliage of thriving plants.

We may congratulate ourselves, it seems, on an installation that has received greater spontaneous approval and is giving more genuine pleasure to our visitors than any previous effort, at least in this department. We have not reached the limit, of course. It is easy to envisage a building entirely devoted to a series of such enclosures, in which the world's most engaging birds could really be given the prominence they deserve!



These are adult and young (upper and lower) Metallic Dragonfish (Bathophilus metallicus). *Thus prepared for study, their entire skeletal structure shows through the transparent flesh.*

Slaying Scientific Dragons

They Lurk in the Sea's Eternal Darkness Until They Reach the Laboratory Table, to be Named or Renamed

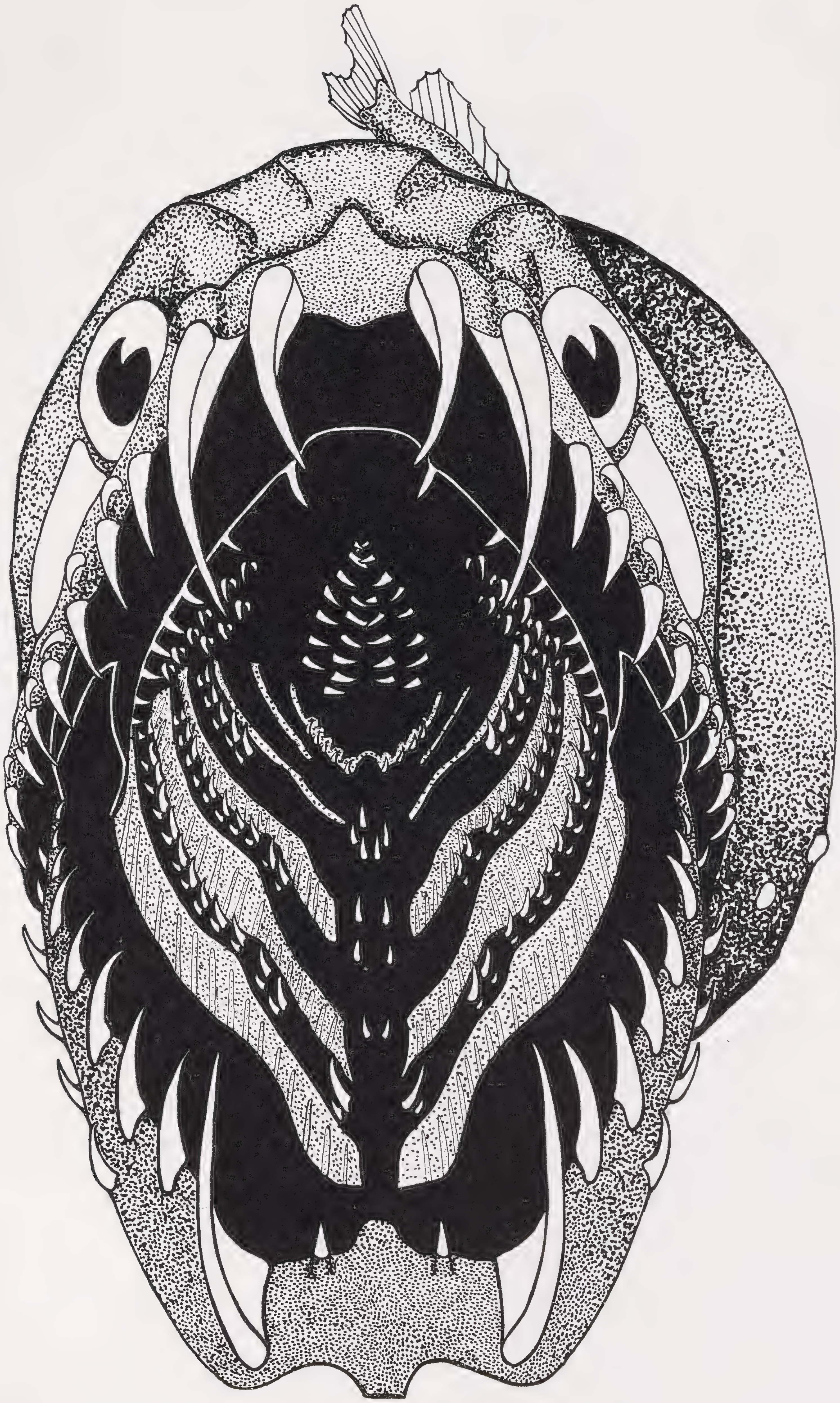
William Beebe

ON the fifteenth of April, 1929, the sea off Bermuda, under a hazy sky, was moved by a short, low swell. Our beloved trawling tug, the *Gladisfen,* ploughed slowly southward and when nine miles off shore slowed up and stopped. Six deep-sea nets, one after the other were passed overboard and more than a mile and a half of wire payed out.

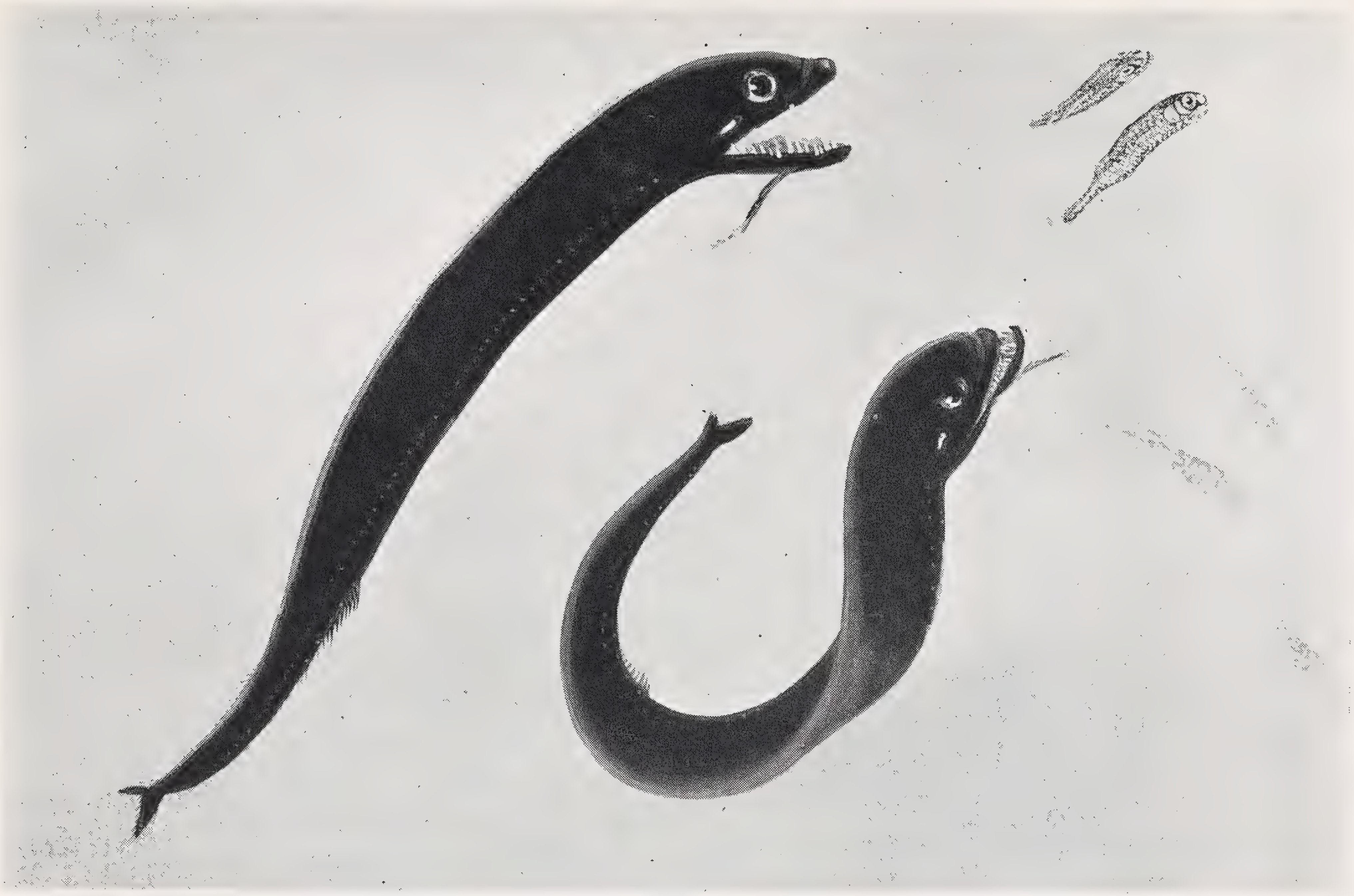
The third net from the top was Number 23, and for four hours it was pulled slowly along through the icy blackness five hundred fathoms down. Later, in our Nonsuch laboratory, in the jar at the end of this net I found our first dragonfish. Its size was unimpressive, a scant four inches, but to any swimming creature from three inches down it must have been a fearsome sight: if it had been a dragon of fairy-story size its fangs would have been shining scimitars a foot long. The word "shining" has a very real meaning, for the brownish-black skin of its slender form glowed with a sheen of bronze iridescence. In the eternal darkness half a mile down below the surface, from which we had brought it up, it had been a living, moving constellation, for on its body were two hundred and fifty purple lights, many set in frames of gleaming gold. A silvery-white beacon glowed close behind its eye. From the chin dangled a slender, snaky barbel, almost as long as the whole body, with two bulbs near the tip. The first was clear pink, but for a short time in our dark-room it gave off a soft, penetrating green light.

This first dragonfish was known as the Double-bulbed, *Eustomias bibulbosus.* It was the third of its kind ever found, and even today, ten years later, only a dozen have been taken, eight of them by ourselves.

Dragonfish, as we call them from their resemblance to the conventional dragons of Chinese painting and sculpture, belong to the family of deep-sea fish known among scientists



A Beacon-finned Dragonfish (Chirostomias pliopterus) *might well appear as a fearsome sight to some smaller creature. This is a front view of its head, with its mouth gaping wide open.*



These minor monsters are Golden-barbeled Dragonfish (Eustomias silvescens) (née satterleei), *pursuing schools of Lanternfish and small, deep-sea crustaceans on which they feed.*

as Melanostomiatidae, which is what Aristotle would have said when he meant Black Mouthfishes. For a popular name I prefer Dragonfish.

Published accounts of the collections and scientific studies of the Department of Tropical Research of the Society fall naturally into two distinct phases—the technical and the popular. To us, the staff members of the department, the former is far and away the more important, for the character and amount of this result reflect the success or failure of our years of preparation in school, university and graduate work. The test of its accuracy and truth should withstand all future critical reinvestigation: it must add something permanent to the foundations of human knowledge.

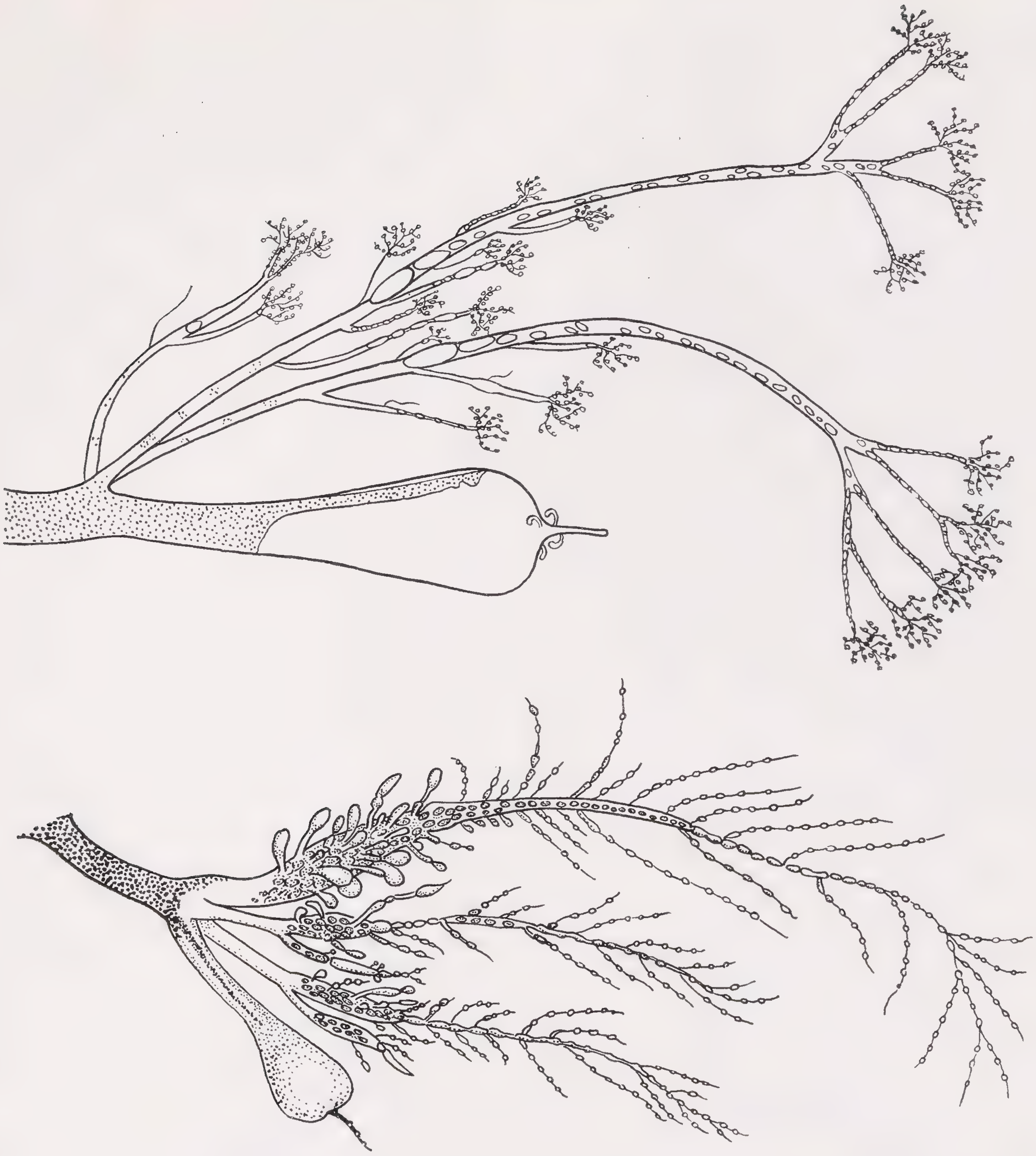
While many of the general results of technical discoveries can and should ultimately be translated into popular language, yet the great mass of detail must remain within the sphere of abstract scientific parlance. For example in regard to the skull of our Double-bulbed Dragonfish we may say truly that the mesethmoid is provided with lateral processes; the parietals are absent, while the palatines and ectopterygoids are loosely attached by ligaments to the mesethmoids and quadrates respectively, but firmly fastened to the premaxillaries and maxillaries.

I can assure the reader of this article that all the above facts are true as well as important. If there is any resentment at the complete incomprehensibility of this knowledge as stated, may I direct the attention of the disgruntled seeker for popular information to the following:

"Wisielismy na glebokosci 923 metrow. Czy chcielibysmy juz powracac do gory? Owszem chcielismy."

This is sheer gibberish to me, but I find it on page 203 of a Polish translation of *Half Mile Down* which has this moment arrived in the mail. By painful correlation of line and word I find it is what one Pole says to another when he wants to quote from page 223 of my volume, where I wrote "We were swinging at 3028 feet. Would we come up? We would."

I return to my osteological mouthful with relief. If this other is popular writing in Poland,



Detailed drawings of the barbels of the Golden-barbeled Dragonfish shown on the opposite page. The upper one is the barbel of the female Dragonfish; the lower that of the male.

and if there are some 32,000,000 human beings who can derive clarity and pleasure from its perusal, I am all for helping them fight for their country and language. And it will make us all hesitate to criticize what we do not understand.

After this rather prolix and pedantic outburst I will briefly say that I intend this article to be an elucidation of what happens to any deep-sea fish from the time it first rises into the light of day in the net, until it finds a permanent place in the collection of our department, and the information derived from it appears in a technical paper in *Zoologica.* Popular accounts need no explanation, whether as long articles, or such short notes as that on page 32 of the January, 1939, *Bulletin.* It is only necessary that these popular contributions be couched in clear, untechnical language, that they be as accurate as the others, and in fact based upon our scientific studies.

As our deep-sea Bermuda trawling is in abeyance for a short time, Jocelyn Crane and I considered it an excellent time to study and monograph the specimens of dragonfish in our collection.

The moment a dragonfish is observed in the net, if it shows signs of life, it is placed in ice-cold salt water and when it has recovered lost vitality it is taken into a dark-room. Here, both with and without induced excitement from touch or from ultra-violet rays, the color, intensity and control of the light organs are recorded, together with all other activities. Later, in the laboratory, it is weighed, measured, tentatively named, labelled and preserved. If it appears to be a species new to science it is set aside for special study. So much for preliminary routine.

In the course of the fifteen hundred-odd nets which, during eight years, we have drawn in the deep waters off Nonsuch, Bermuda, we have captured a total of 250 dragonfish. These belong to 10 genera and 32 species. All other dragonfish ever taken in all the seven seas number only 1,450 individuals, of 16 genera and less than 100 species. So within our eight-mile cylinder of water, one five-millionth of the ocean contents of the world, we have secured two-thirds of all dragonfish genera and one full third of all the species. This seems almost incredible, but it is true, and encouraged us to undertake intensive work on the group.

The first thing to do is to assemble all published literature on this family in whatever language and for this our really remarkable departmental library proves wholly adequate. Then we marshall, sort and list all our collections. After a thorough survey, trips have to be made to the museums of Washington, Harvard and Yale to examine the original types—those sacred individuals which are never allowed to leave their sanctuary institutions. Rare species not represented in this country must be borrowed from foreign museums such as those in London and Copenhagen.

In monographic work we cannot be satisfied with the mere externals but must become familiar with the skeleton and claim acquaintance with various bodily organs. So certain key individuals are turned over to Gloria Hollister who magicks them with dye and potent chemicals, turning the dragonfish into permanent, scarlet X-rays, swimming in glycerine. An artist must constantly be ready at our elbow to make sketches of unexpected characters of barbels and bones and later to combine them in finished drawings. In the present case of the dragonfish we were fortunate in having Harriet Bennett, fresh from five years at Cornell, where under instruction from an old friend of the Zoological Society, Walter King Stone, she had gained facility in biological draughtsmanship.

The cost of oceanographic collecting is very great and deep-sea fish are, at best, relatively few and far between; in fact many species are known only from one or two individuals. Their rarity and bizarre appearance has lent them unusual value and in the past, I and other workers in this group have been all too satisfied to depend on the more conspicuous external characters, readily studied in entire, untouched specimens. This time we were ruthless and cut open everything, sexing types, with permission, even in alien collections. The results were most surprising and have worked havoc with many supposed species. Until actual identification of species is stabilized it is hopeless to attempt any final results in evolutionary study.

Let us take the genus *Eustomias* to which our *first* Double-bulbed Dragonfish belonged. It comprises fifty-seven of all dragonfish species—or it did until we began to dissect the various forms. Then we found that some species, based on variations of the barbel, were really only males and females of the same form. The big cheek beacons are another misleading character. Both sexes in their youth have them well developed, but as the fish get older the luminous organs become relatively larger and more brilliant in the males, but in the opposite sex contract, shrivel and are often completely extinguished. Why elderly female dragonfish cannot flaunt a pair of flaming head lights is a complete mystery, but as a guide to species this character is almost useless.

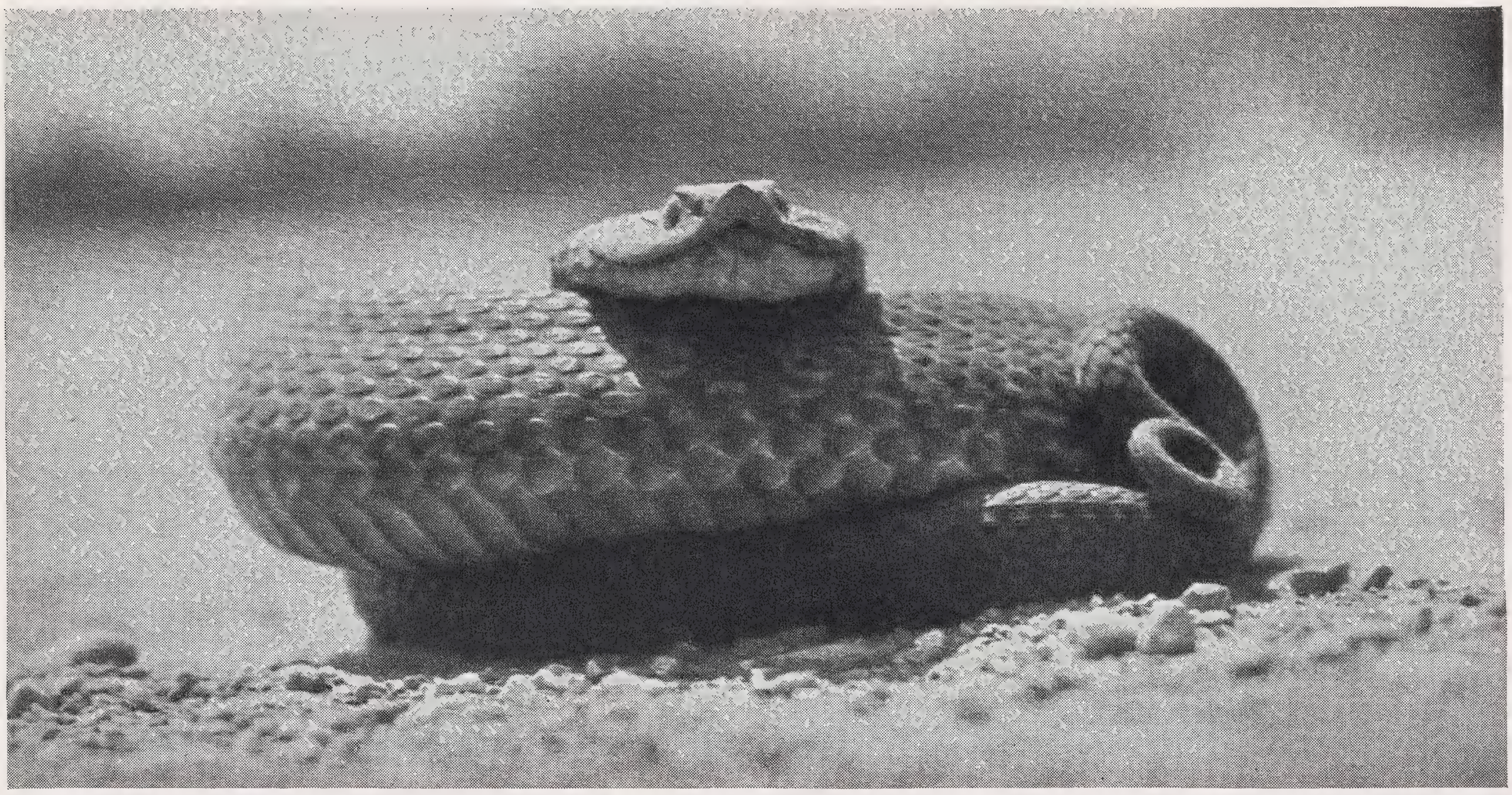
We found a number of fish which, externally appearing completely adult with black skin, fully developed light organs, strong fangs and elaborate barbels, yet upon dissection proved to be so immature that their sex could not be told. Such species are thus based upon unreliable immature characters. If an early explorer in America had secured the skins of two birds, one with clear gray and rufous plumage, and the other thickly spotted above and below with black, the reasonable thing would be to give each a different name even though later came the knowledge that one was an adult robin and the second a full-sized young bird.

When such confusion arises, priority in name is as irrevocable as the seating at a royal banquet. Scientific taxonomy plays no favorites and one's pet name must go whether antedated by ten years or a few lines on the same page. In 1933 I described a most elegant dragonfish with amethyst-violet and gold lights and a bushy barbel of rich chrome yellow and apple green. I thought it worthy of the honor of being named *satterleei* after my dear friend Herbert L. Satterlee. We have just found out that this individual is a full-grown female, and in the light of our present discoveries it becomes only too evident that this is but the weaker sex of a single, smaller, male dragonfish described three years earlier from the Caribbean. So my cherished species is no longer *satterleei* (*sic transit gloria nominis*) but becomes the second known specimen of *Eustomias silvescens.*

In the course of our present studies we have had to reduce the number of genera of dragonfish by five, and the species by thirty-two. This is due to new knowledge derived from careful sexing, from the advantages of working with transparent preparations, from larger series of individuals and from the international helpfulness and generosity of fellow ichthyologists.

I have tried to tell something of the writing of the monograph which is now in press for *Zoologica;* a paper of 174 pages with 77 illustrations dealing with the Society's collection of dragonfish. It is hopelessly technical, it has neither bright introduction, nor thrilling climax nor happy ending. But it embraces all the knowledge that two of us could put into it, and presents as thorough as possible an understanding of the beings and lives of these strange dragonfish—inhabitants of a world wholly alien to our light and warmth and gentle atmospheric pressure. Working with creatures of the deep sea is like flying blind, with hidden mountain peaks of ignorance rising in every direction.

As we look at the rows of jars, each with its particular species, we think of the thousands upon thousands of other dragons swimming about on their glowing paths. And we feel a little satisfaction that our few have fulfilled a small part of their destiny.



Photos by Ben East

The Hog-nosed Snake is an accomplished bluffer—so good an actor, indeed, that often it is mistaken for a really dangerous snake and killed before its little comedy runs its full course. These pictures show the snake's typical actions when surprised or cornered.

The Not-so-Wise Serpent

There Is Guile in the Behavior of the Hog-nosed Snake, but Too Often It Brings Ill-luck to the Serpent

WILLIAM BRIDGES

IT'S an old, old story to Dr. Ditmars and his secretary.

"—and it's neck was spread out like a cobra, and it hissed at us. The gardener knows all about snakes, and he said it was a Copperhead. So he killed it. Do you think its mate will come back? Do you think we ought to get some snake-bite serum?"

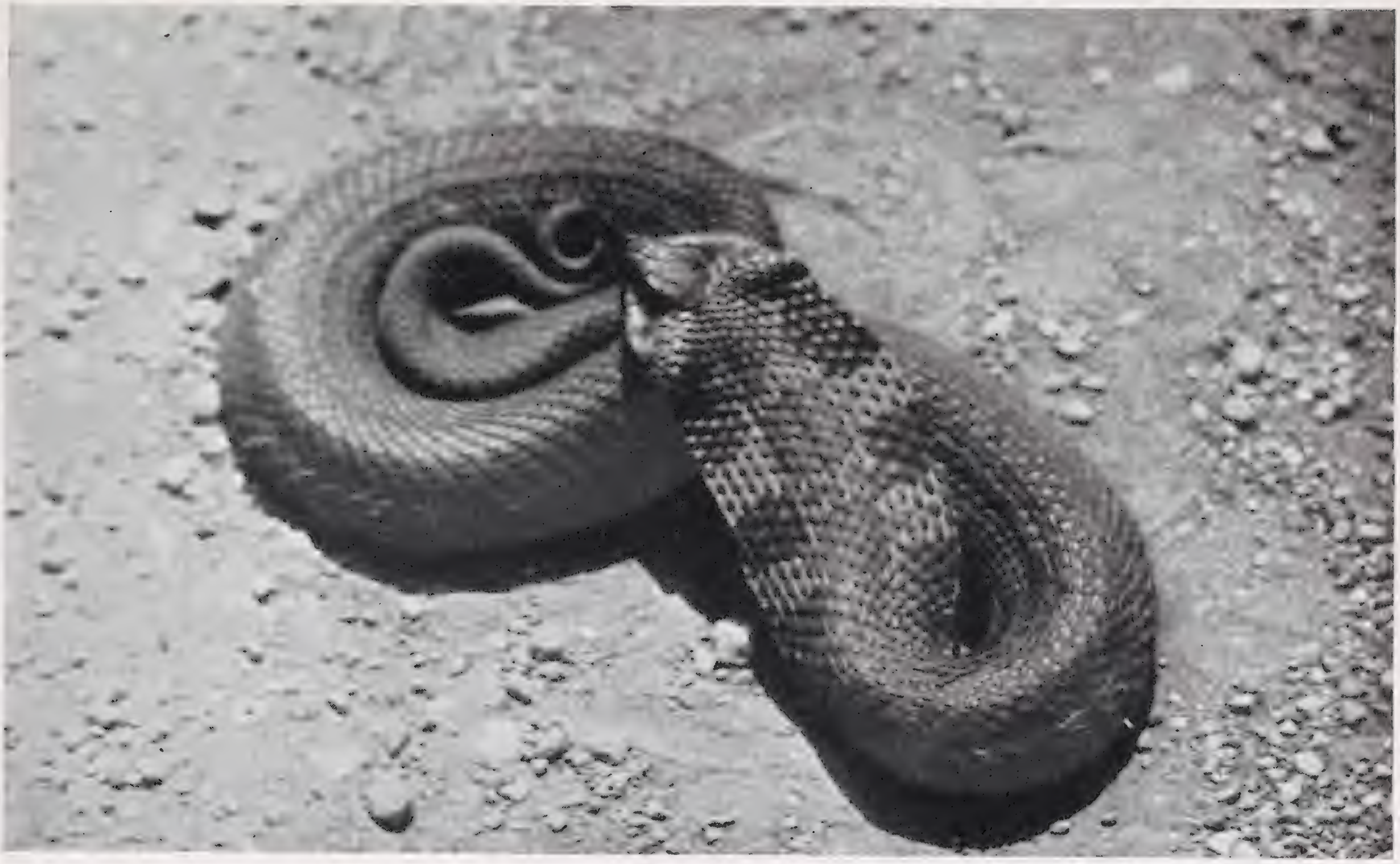
After a few hundred repetitions of that spring and summer refrain, "So the gardener (or one of the neighbors, or my husband) killed it," one begins to wonder just how much real advantage accrues to the harmless Hog-nosed Snake from its pseudo-aggressive behavior.

For the Hog-nosed Snake it is—gardeners, neighbors and husbands notwithstanding. Dr. Ditmars' secretary has reached the point of being able, she insists, to diagnose "Hog-nose trouble" over the phone simply by the volume of alarm in her questioner's voice!

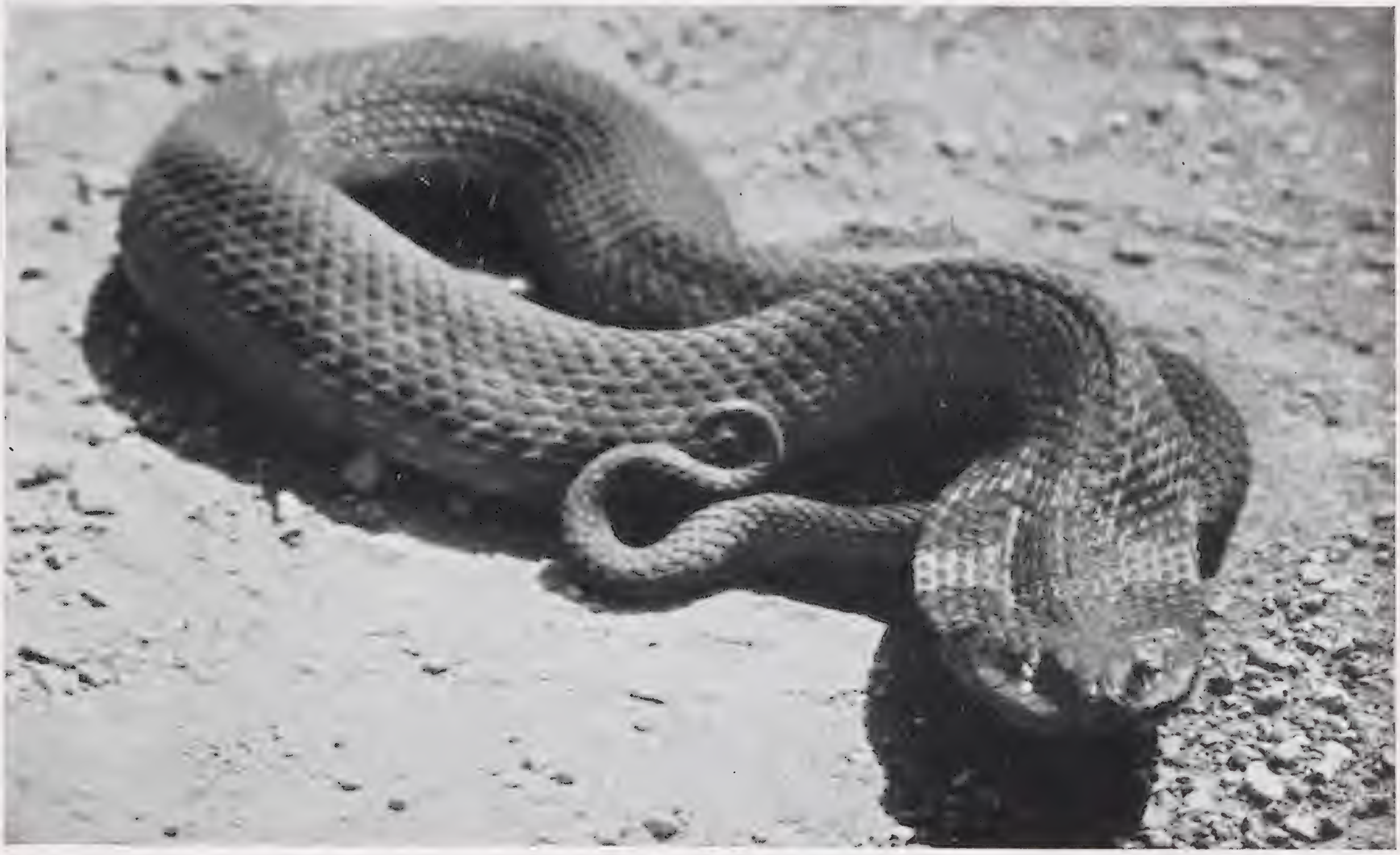
It is a minor matter for curiosity why the Hog-nose is almost invariably condemned to death under the name of Copperhead. Probably because most persons in the northeastern States know that only two kinds of dangerous snakes are found here—Rattlesnakes and Copperheads. This snake looks dangerous; ergo, it *is* dangerous. It has no rattle—so it is a Copperhead.

The Hog-nosed Snake *looks* dangerous, *acts* as a dangerous snake might be imagined to act. And that, in perhaps a majority of its encounters with humans, is its undoing. Out of hand it is labeled dangerous, and destroyed.

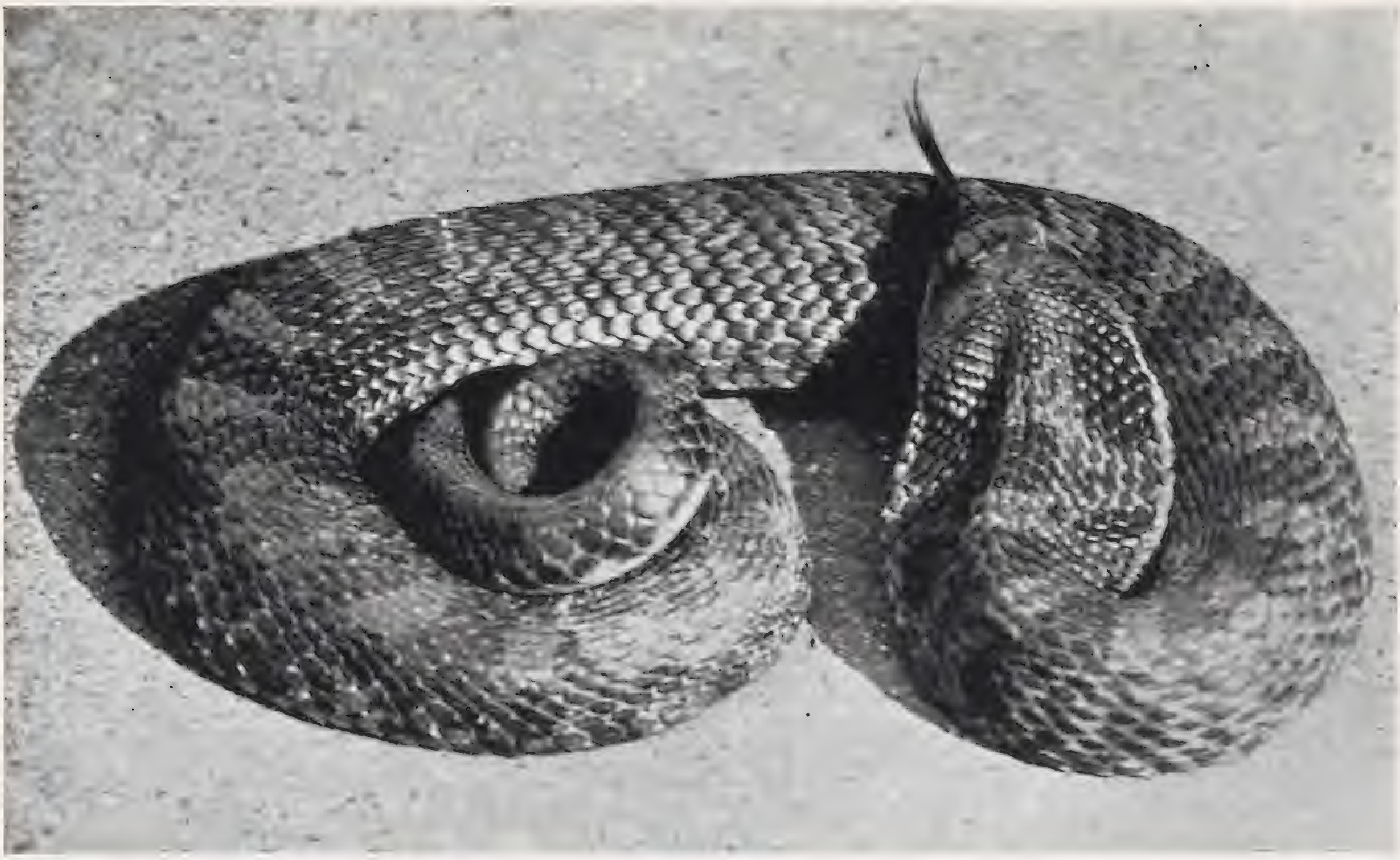
What purpose useful to the snake is served by this strange habit of hissing, of expanding the head and neck, by the final pathetic trick of "playing dead"? A bluff, effective as a defense against some of its enemies, it is supposed. But not, it would seem, against such enemies as gardeners, neighbors and husbands.



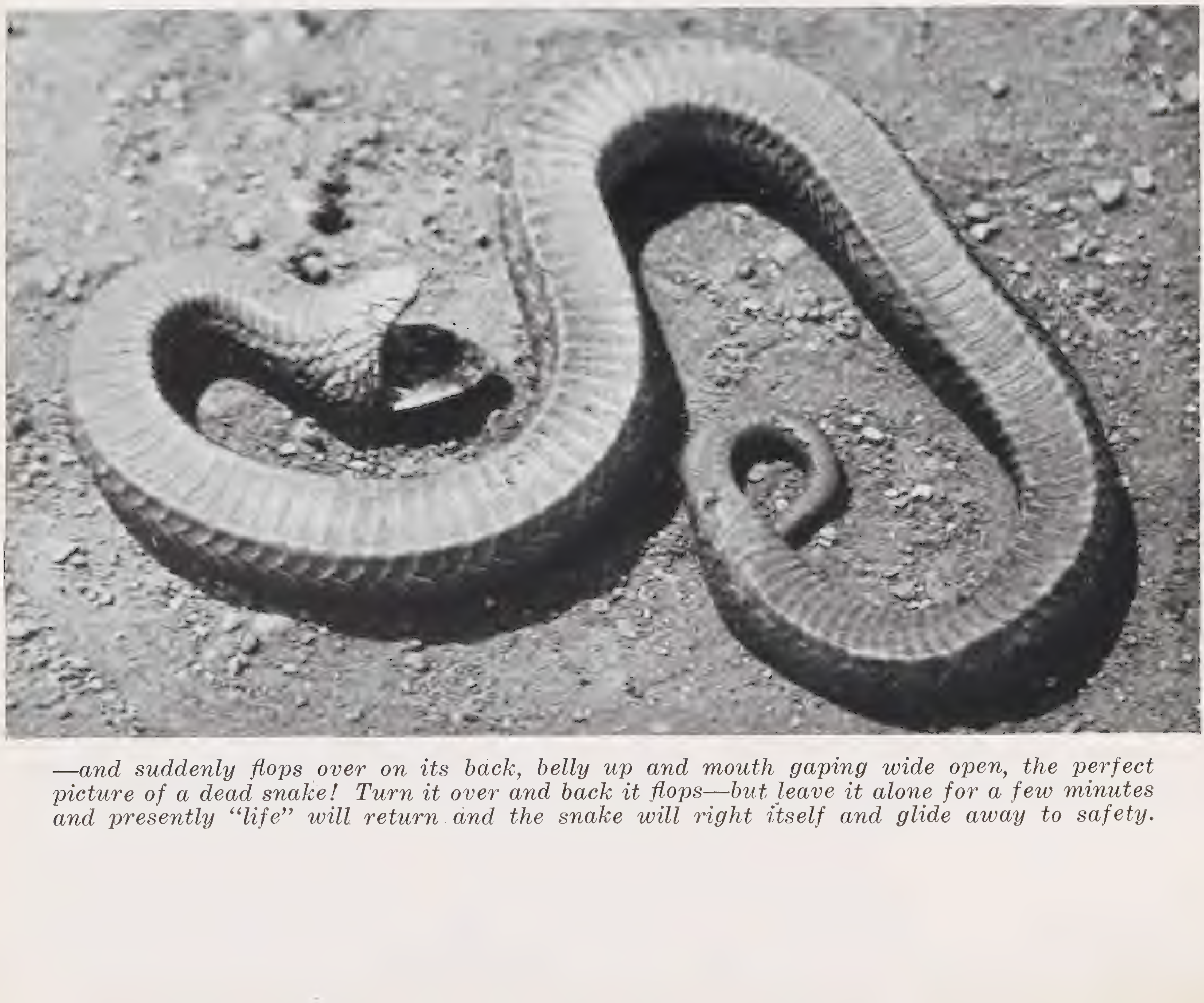
The Hog-nosed Snake (which gets its name from the upturned, plow-shaped snout seen clearly in the picture on page 124) has the power of expanding its head and neck to almost twice their normal size. This it does quickly, to the accompaniment of a loud, sharp hiss.



Sometimes the snake will even strike at a threatening intruder—although it apparently strikes with its mouth closed! Nevertheless, it is easy to see why a snake that expands its neck like a cobra, hisses loudly, and strikes is mistaken by many persons for a dangerous reptile.



If these aggressive preliminaries fail to drive off the intruder, the snake prepares for the final act of its little drama. Its aggressiveness vanishes—it has done its best to play the part of a venomous serpent, and its best was not good enough. So it begins to uncoil—



—and suddenly flops over on its back, belly up and mouth gaping wide open, the perfect picture of a dead snake! Turn it over and back it flops—but leave it alone for a few minutes and presently "life" will return and the snake will right itself and glide away to safety.

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All pictures not otherwise credited are from the photographic collection of the New York Zoological Park and the Aquarium.

Notes from the Zoological Park and the Aquarium

Octopuses and Fishes from Florida

Some of the showiest and best exhibition fishes and invertebrates of the whole Atlantic coast live near or in the coral reefs about the Florida Keys. This June Mr. John Shea of the Aquarium staff established headquarters at Key West, Florida, and returned aboard the *S.S. Alamo* of the Clyde Mallory Line on July 5 with approximately 1,500 tropical marine creatures.

Most notable among the invertebrates were six octopuses. These animals are notoriously hard to transport. Not only do they succumb quickly to relatively little handling or annoyance, but they are very sensitive to toxic substances in the sea water surrounding them. They can escape through amazingly small holes in their confining vessels and usually fight with one another if kept together in close quarters. To solve all these problems, yet not take up too much valuable space, each octopus was confined in a two-quart, lidded, metal can, commonly known as "growler," into which numbers of small holes were punched. These were suspended in one of the large wooden shipping tanks, and a good current of fresh sea water maintained at all times possible. The success of this method may be judged by the fact that of nine octopuses starting the five-day journey, six survived in excellent condition—a fine record.

Among the fishes a small barracuda was outstanding. This specimen gives every promise of growing up to impressive proportions in its tank at the Aquarium. The infrequency with which this species is exhibited results from its inability to withstand transportation. Those which have arrived not in a dying state have settled down and become quite satisfactory exhibits, keeping, however, the savage disposition accredited them in nature.

One Marbled Grouper, *Dermatolepis marmoratus*, was included in the collection. This is only the third specimen of this handsome, rare species ever to appear in the Aquarium. The first arrived in 1914 and was the type specimen, that is, the first individual of that particular species known to science.—J. W. A.

The Passing of Charlie

Extreme longevity of specimens is a point of pride with all who have to do with animals in captivity. As old individuals get older, they are coaxed and cozened to become even more so, not only for the establishment of records but because of the affection that grows with long association. When "Charlie Chaplin" died on July 17, 1939, he left a void that another Kagu—if we should get one—will not fill.

We have had three Kagus (*Rhinochetus jubatus*). Of two received in 1914, one bird lived only a few months, the other sixteen years and two months. On November 5, 1920, the late Ellis Joseph brought us "Charlie Chaplin." He lived here for eighteen years and eight months, succumbing to the ravages of cirrhosis of the liver. One suspects that Kagus may have lived longer in captivity but the best record available is one quoted by Major Stanley S. Flower, from P. Chalmers Mitchell, of sixteen years and four months.

Aberrant member of the Order of Cranes, the Kagu is a definitely fantastic bird, found only on the island of New Caledonia, in the Loyalty group. Threatened with extinction, the Kagu is now rigidly protected by the French Colonial Government, and it seems unlikely that "Charlie Chaplin's" niche will ever be reoccupied.

Newcomers from Africa

Three weeks too late to provide a special event for our guests at the Spring Safari, two young Reticulated Giraffes (*Giraffa camelopardalis reticulata*), a Giant Forest Hog (*Hylochoerus meinertzhageni*) and a Gray Bush Pig (*Koiropotamus koiropotamus kenlae*) arrived at the Zoological Park from Africa on June 8.

This is the first time anyone in the New World has exhibited the Giant Forest Hog and our specimen, now well recovered from the effects of its long voyage, is a worthy representative of its kind. A female, it will probably never attain the impressive dimensions of a male, but it is nevertheless an interesting example of the Wild Swine group.

The Forest Hog and the Bush Pig are on exhibition in the Kangaroo and Small Mammal House. The two Reticulated Giraffes—both young and lively specimens—are housed with the Antelope collection.

In the September-October issue of the *Bulletin*, Dr. C. W. Leister will present a survey of the Wild Swine that have been exhibited in the Zoological Park in recent years, with photographs of representative types.

PUBLICATIONS OF INTEREST

BIRDS OF LONG ISLAND. No. 1. Issued by the Bird Club of Long Island, May, 1939.

Bird study as a hobby has made immense strides in recent years. While it is true that compilation of lists still fascinates great numbers of amateurs, many have passed this stage and moved on into the field of observation. Most professional ornithologists are so occupied with specific tasks that it is impossible for them to find the time for extended local field work. In these days of increasing interest in the life, habits and behavior of birds, the "amateur" is coming into his own and to him we look more and more for increase of our knowledge of the intimate details that have assumed new importance.

Long Island has long been a fertile field for the development of such observers and much information of incalculable value is tucked away in their notebooks. The difficulty has been a medium of publication and it appears now that the Bird Club of Long Island has provided the means for making this material available to all workers. This first issue is devoted to the dainty and little-known Piping Plover and contains contributions by LeRoy Wilcox, Allan D. Cruickshank and John T. Nichols—the latter, at least, hardly an amateur. Mr. Cruickshank contributes some excellent photographs and there is a pleasing colored plate by F. L. Jaques, including the hitherto unfigured downy and first plumages of the young.

Mr. Wilcox's article contains much data of value and his suggestion that variable incubation periods may be accounted for by definite differences in the eggs of each female seems especially interesting. Mr. Cruickshank's remarks on injury feigning are made with fairness and will gain many sympathizers for his point of view.

Everyone interested in the study of bird life histories will hope for the continuance of this promising enterprise. Copies of the first number may be obtained at One Dollar each from Mrs. Richard Derby, Treasurer, Bird Club of Long Island, Inc., Oyster Bay, New York.—L. S. C.

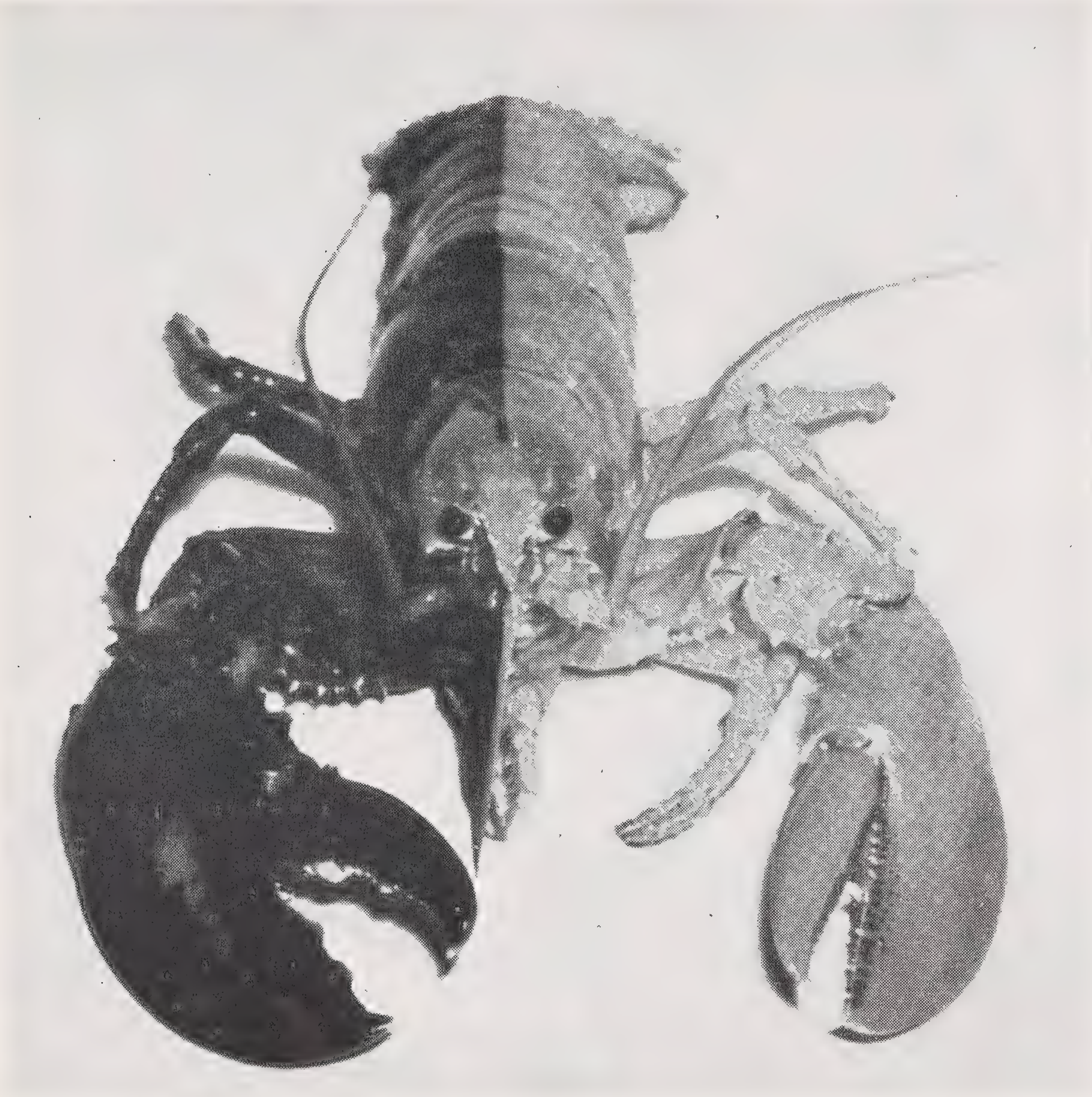
"Half-boiled Lobster"

Variations in color of the American northern lobster are not extremely rare. Every year red, blue and cream-spotted or calico specimens are taken by the commercial lobstermen of the Atlantic coast. On June 30, however, the Aquarium received (and now has on exhibition) an abnormally-hued specimen particularly noteworthy both for its rarity and scientific import. The right half of the animal is more or less ordinarily colored; that is, it is predominantly very dark green, with black and a little red interspersed. The left side is a bright orange-red throughout. This striking pattern led Nicholas and Harry Hansen of Brooklyn, who captured the creature off Coney Island, humorously to call it a "half-boiled lobster."

The line of demarkation between the two hues is perfectly sharp and extends exactly along the middle of the back all the way to the end of the tail. Only in the region of the head does it extend over on the right side. All the appendages on the left side are orange-red, none on the right. The line of separation is not so apparent on the underside, but this is because the pigmentation in general is less intense there.

The cause of this unilateral bicoloration has proved puzzling to biologists who have seen the lobster. Any adequate theory of crustacean coloration and its development and control should be able to account for the pattern on this specimen.

—J. W. A.



This is the "half-boiled lobster." The normally-colored right side, being dark green, photographs darker than the abnormal red left side.

Serpents of the Northeastern States

By RAYMOND L. DITMARS

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"Serpents of the Northeastern States" was originally published as a complete number of the BULLETIN and several reprintings were quickly exhausted. It has been republished in a new format, somewhat revised as to text and nomenclature, and four photographs have been added.

60 pages, 41 illustrations. *50 cents postpaid.*

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NEW YORK ZOOLOGICAL PARK
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No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

Clark and Fritts, New York, Printers.

NEW YORK ZOOLOGICAL SOCIETY

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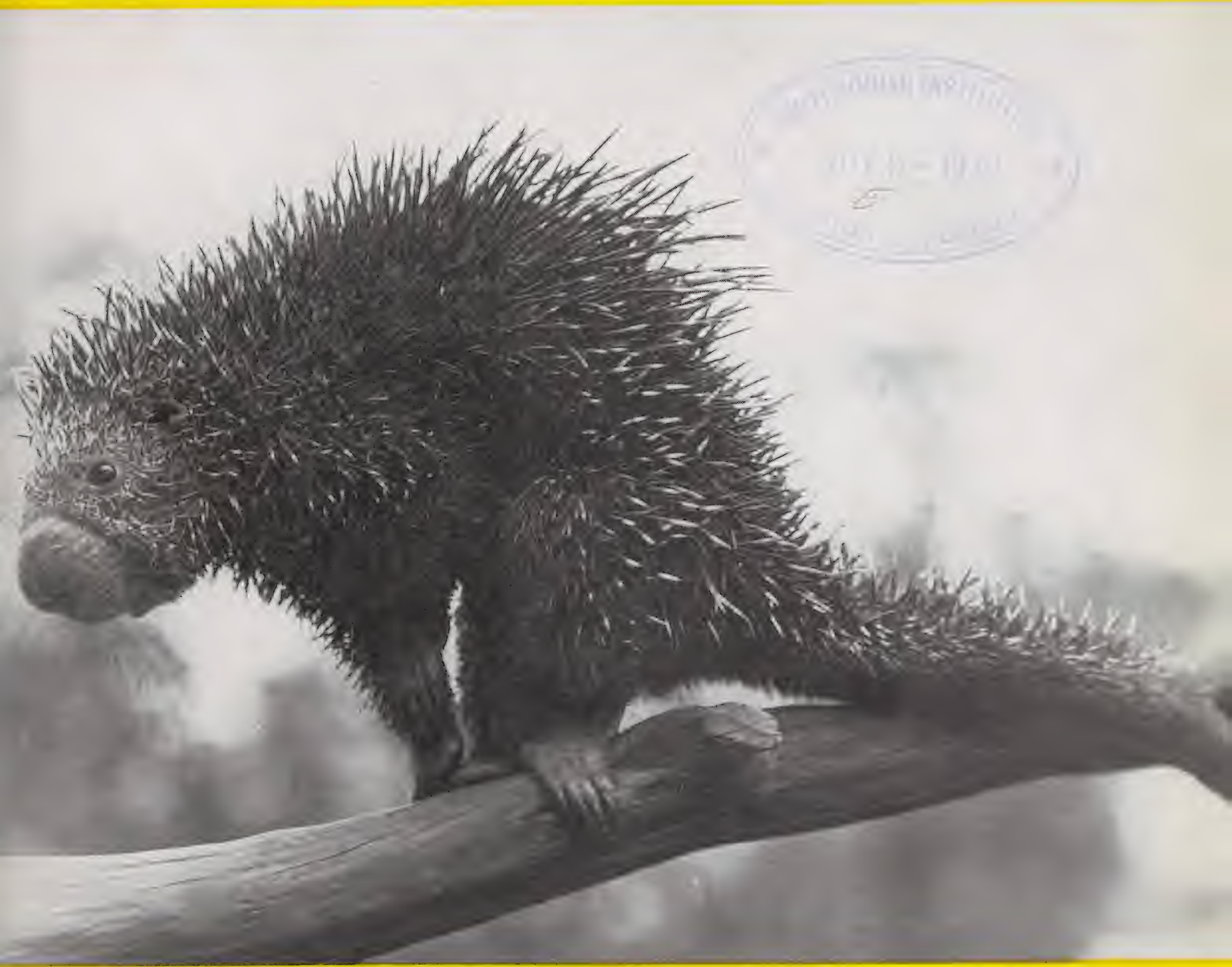
XLII, No. 5 September-October, 1939

BULLETIN

NEW YORK ZOOLOGICAL SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

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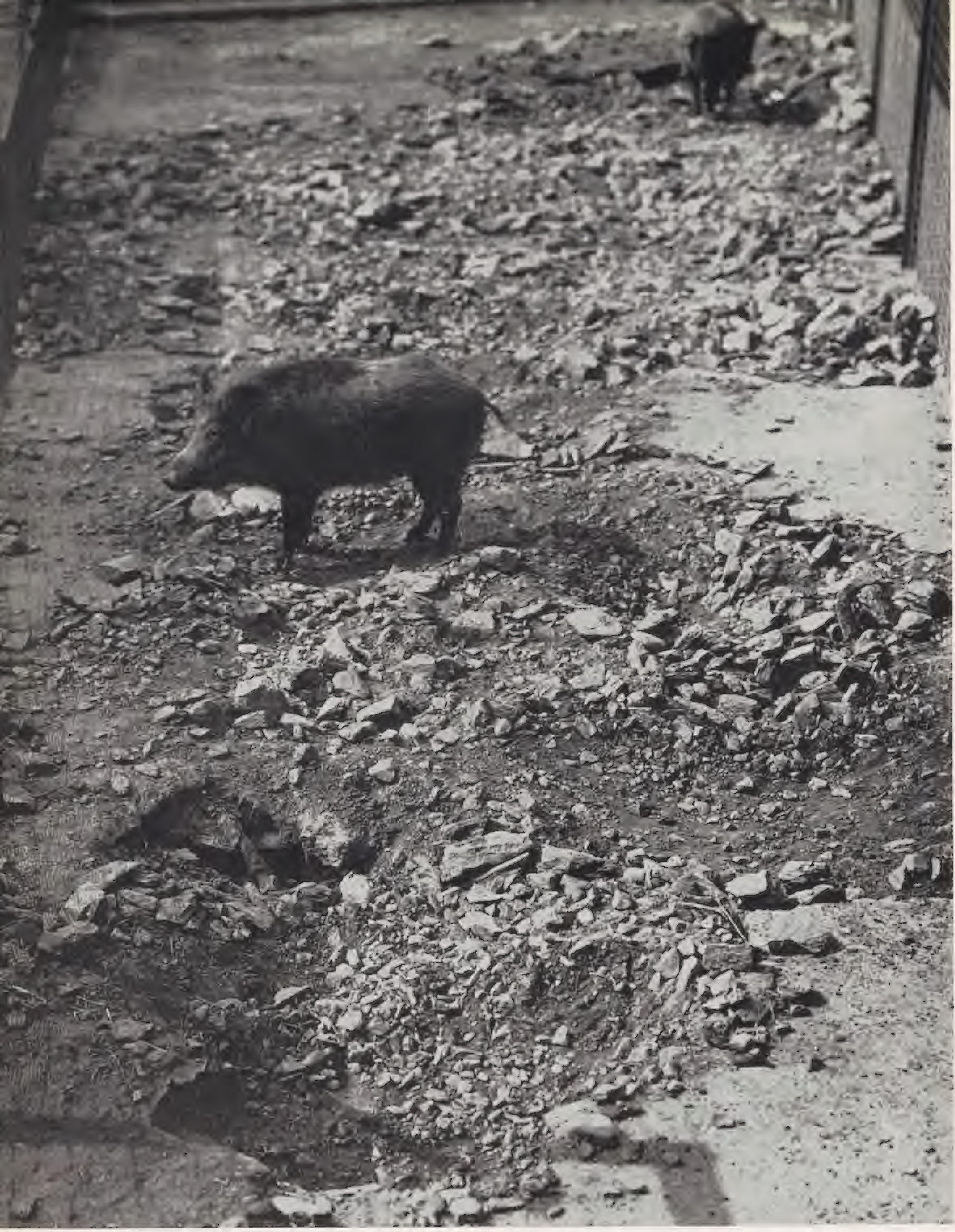
Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



Wild swine and domestic hogs may bear little resemblance to each other as far as mere appearance goes, but they are alike in their love of rooting. This corral was smoothly paved with macadam before a pair of North African wild swine were quartered in it.

BULLETIN
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The Wild Pigs of the World

A Brief Natural History Résumé of the Family Suidae, Especially the Species that have been Exhibited at the Zoological Park

Claude W. Leister

In discussing wild pigs of the family *Suidae* a generalized description seems necessary, in spite of the fact that practically everyone can recognize a member of this group, be it wild or domestic. It seems sufficient to say, however, that all wild pigs are small to medium-sized, short-necked and thick-bodied, rather primitive ungulates without horns or antlers, for defensive weapons relying upon a pair of greatly enlarged canines or tusks in both jaws. Perhaps the most outstanding characteristics are found in the construction and function of the snout. We find that the tip of the muzzle is furnished with an exceedingly tough cartilaginous disc which is perforated in the middle by the nostrils. This nasal disc is supported by a peculiar bone, the pre-nasal, found in no other animals.

In the pig's snout nature has produced a rooting device without a peer. Few persons realize how cunningly powerful it is. We can best gauge its possibilities by watching one of these natural steam shovels at work. The corrals in which our wild swine are confined are paved with macadam. Some years ago a pair of North African wild swine were released in one of these enclosures. In a few days, to all appearances, a new paving job was in progress. Men with pick and shovel could not have done a more thorough job of tearing up the tightly packed crushed rock.

Wild pigs are entirely Old World in their distribution. No true pigs have ever occurred in the Western Hemisphere. The pig-like peccaries, now ranging from Texas to Patagonia, once extended over most of North America. While they are not closely related to true pigs, a common ancestor is probably to be found in an immigrant from Asia in the dim past.

Man, on his climb up the ladder of time, has found the pig to be extremely important to his welfare. Pork has always been an outstanding food item with all primitive races, and it has been stated that the existence of the Malays and Polynesians would be endangered if they were deprived of pigs. There has been much contention in the past as to how the various breeds of domestic swine were derived. We know that great differences in outward appearance have been produced by selective breeding and that when domestic animals are allowed to go feral these selectively produced characteristics rapidly disappear and the animals revert to a generalized primitive form. With this fact in mind and considering the wide distribution of wild pigs it is reasonable to believe that a number of ancestral stocks were furnished by whatever races of wild swine were at hand.

European Wild Boar

The European wild boar (*Sus scrofa*) is familiar to most of us. The animal has been so closely connected with the everyday life of our ancestors that it is firmly entrenched in our folklore and hunting tales from the past.

The wild boar is no longer found over much

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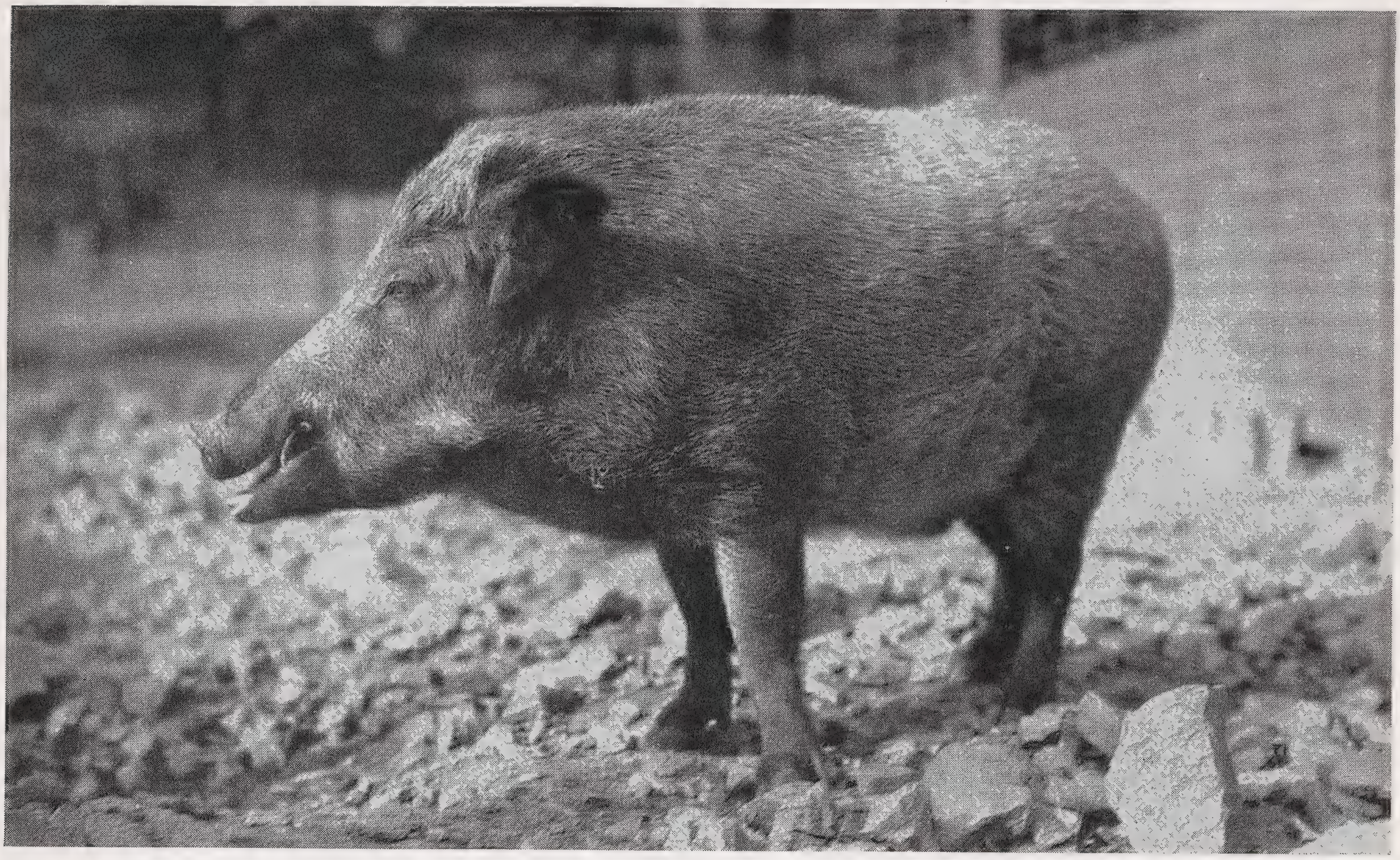
The European wild boar is probably the best-known species of the world's wild swine, and is the most typical. Its distribution formerly was very wide—over all of Europe and, with its various races, through northern Africa and across western Asia to southwestern China.

of its former range but it is of regular occurrence in many isolated forested areas, and boar hunting is still a popular sport. Generally it is now killed in drives but formerly it was hunted with packs of dogs and killed with the lance when brought to bay. The British have taken the sport of "pig sticking" to India, where it has been called "the finest sport in the country." Here the game is pursued by mounted hunters armed with lances. The popularity of the sport is largely due to the fact that "a boar is perhaps the most courageous of all wild animals, and generally fights to the death, receiving spear after spear and charging horseman after horseman with reckless gallantry." A boar's courage can not be doubted. There are instances on record where they have successfully defended themselves against the tiger and truculent individuals have even been known to charge an elephant. Indian shikaris illustrate the courage of the wild boar by saying that he has the hardihood to "drink at a river between two tigers."

Wild swine are omnivorous, although their food consists mostly of roots, bulbs and fungi. They will eat a fair share of flesh whenever the opportunity offers. Their sense of smell is very keen and they are able to follow the trail of a wounded animal to its end. Some time ago we read of a domestic pig trained to point game, a feat which it accomplished in a superior way. Assuming that the olfactory sense deteriorates somewhat under domestication the sense of smell in a wild pig must be extremely keen.

Since the wild boar is so widely distributed over Europe and Asia we would expect to find a number of species and geographical races. Thus we find a half dozen races of the European species, ranging from Kordofan in Africa, north and east through Europe and Asia Minor, to western China. All of these are fairly similar in general appearance but there is considerable variation in size. Spanish and Russian wild boars have the reputation of being the largest and weights have been recorded in excess of 300 pounds.

The already mentioned Indian wild boar (*Sus cristatus*) is slightly smaller than the European species and the dorsal crest of long hairs is



The North African wild swine (of which this is probably the Kordofan race) is quite similar to the European wild boar. The tusks of the European boar and its races are not as long as those of some other wild swine, but they are heavy and nevertheless dangerous weapons.

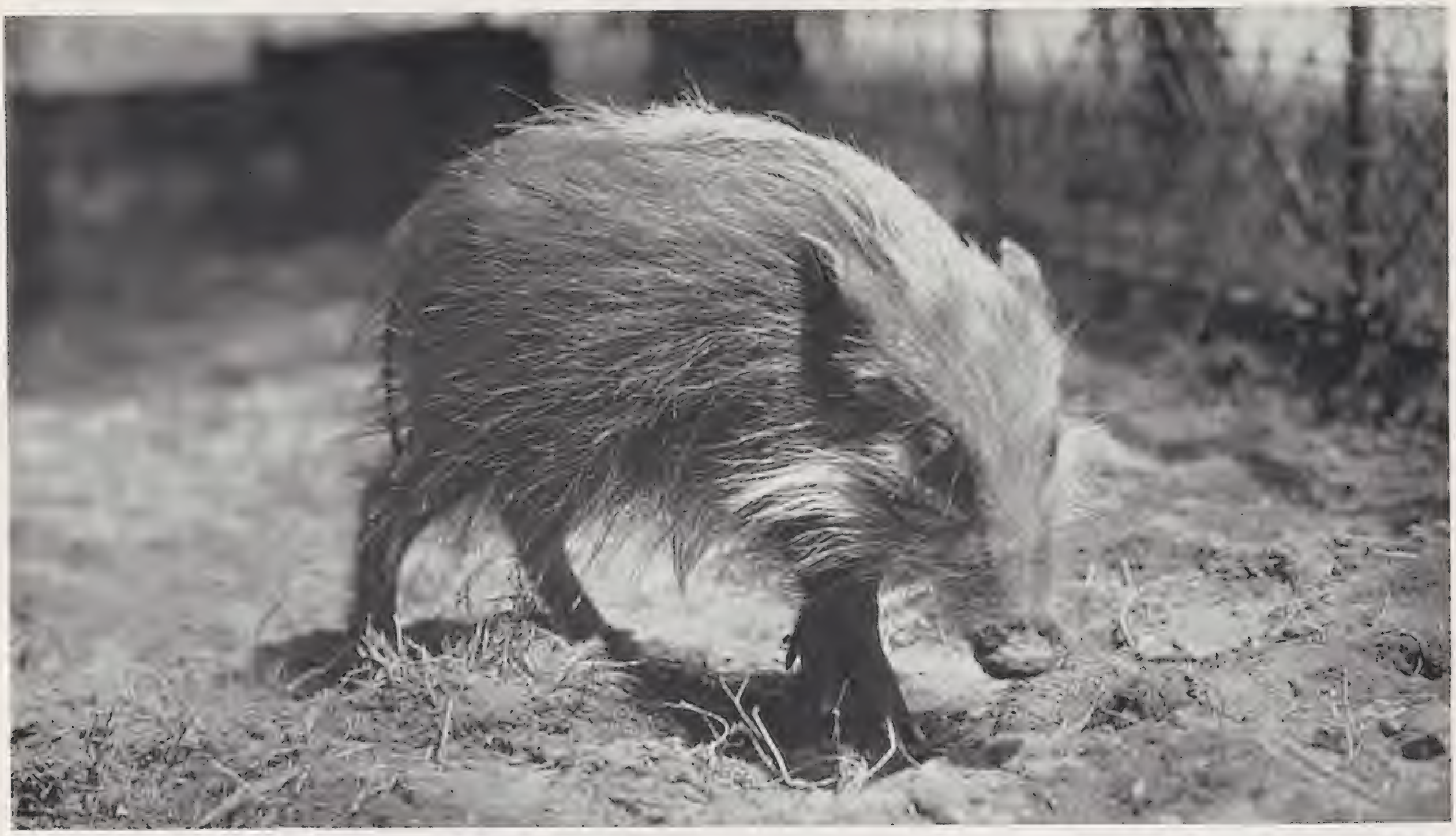
more strongly developed. It has never been exhibited in New York. The cost of transportation for this and other Malay species is scarcely warranted by their exhibition value. Two outstanding East Indian species are the bearded pig (*S. barbatus*) from Borneo, which has cheek tufts of long hair and a long black tail tuft, and the warty pig (*S. verrucosus*) from Java. This pig has warts on its face and the young are uniformly colored, not spotted or striped like other young pigs of the genus *Sus*.

A small species, worthy of special mention, is the pigmy hog (*Porcula salvania*) of Sikhim, Nepal and Bhutan. This is the smallest of the world's pigs, not exceeding one foot in height at the shoulder and weighing about 15 pounds.

Bush Pigs

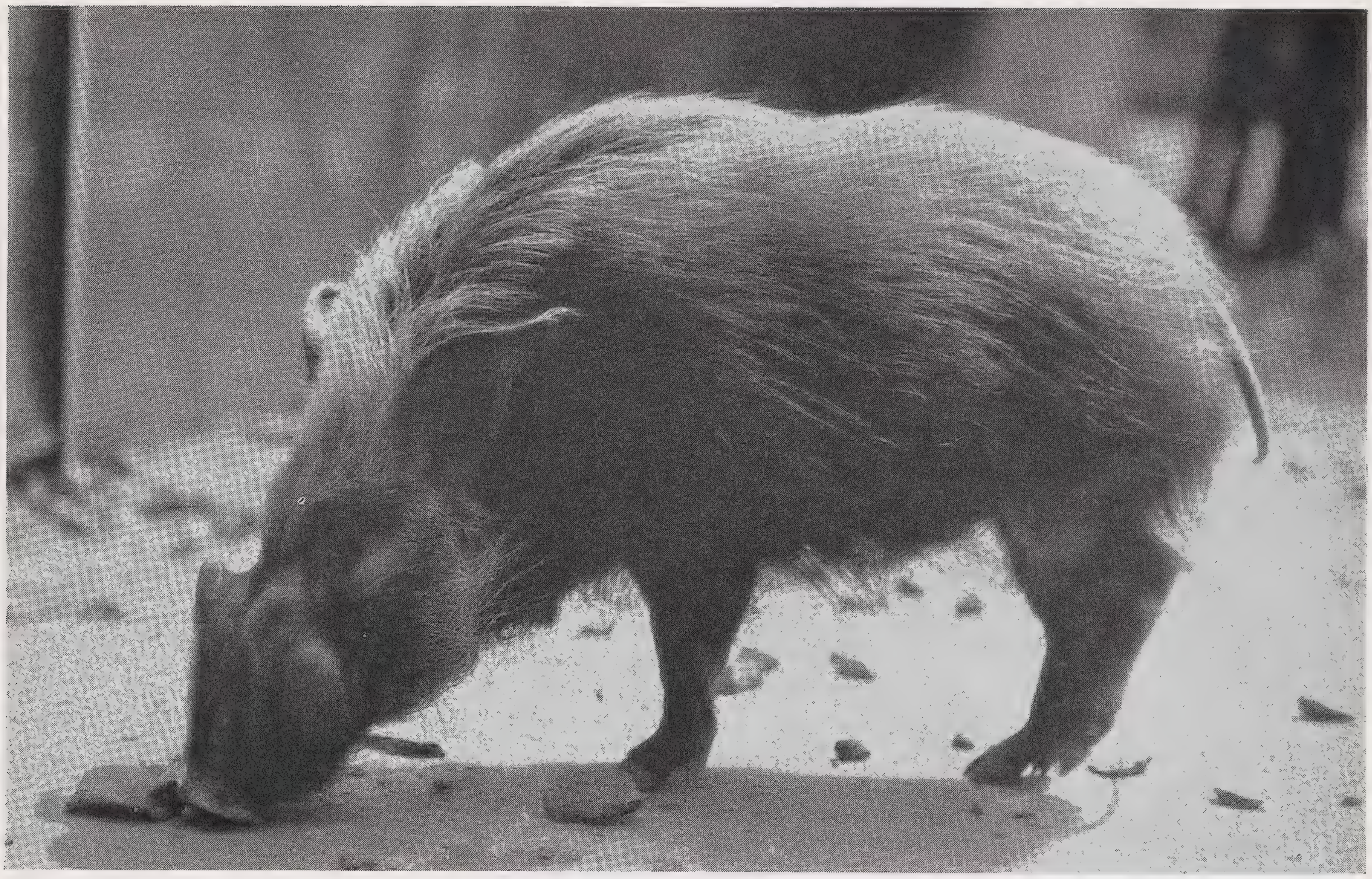
While North Africa contains several representatives of the European wild boar these races are comparatively recent immigrants and differ but little from the typical species. The true African pigs, however, are well distributed through the tropical and southern part of the continent. They have undergone a considerable amount of evolution and several different genera have developed. One of these, the bush pig (*Koiropotamus*) is usually regarded as coming from European or Asiatic *Sus* stock. The skull of the boar has a prominent bony process on the muzzle just beneath the eyes and the first lower premolar has been lost.

Bush pigs are the most brightly colored of the world's pigs. Newly born young are strikingly marked with pale buff longitudinal stripes on a dark brown ground color. This is changed for a bright reddish-brown in young pigs. Old boars of the East African race gradually become black. There is usually a whitish dorsal mane and some white around the eyes. The ears are penicillate. The typical bush pig (*Koiropotamus k. koiropotamus*), the gray bush pig or the bosch-vark of the Boers, in its several forms occurs from the Cape to the Sudan. A small species (*K. larvatus*) occurs in Madagascar but since no other East African ungulates occur in that country it is believed to have been introduced through the agency of man. The West African red river hog (*K. porcus*) is the most brightly colored of all the



The East African bush pig is usually considered as being a descendant of European or Asiatic Sus *stock, although it differs considerably in form. This specimen is a female, and it is interesting to compare its appearance with that of the male pictured on the opposite page.*

The red river hog, or West African bush pig, is the most brightly colored of the world's wild swine. The hair is usually of a bright reddish-brown, shot through with yellowish tints, and there is some white around the eyes and cheeks. The tapering ears bear a tuft of long hair.



The East African bush pig shows its characteristics to greater advantage in this picture of an adult male. The bony processes on the nose are not defensive weapons, but are simply peculiar structures analagous to the warts on a wart hog. They are most pronounced in old males.

bush pigs. It is a brilliant reddish-brown with yellowish tints and streaks of white are found around the eyes and on the cheeks. The ear-tufts, forehead and legs are blackish.

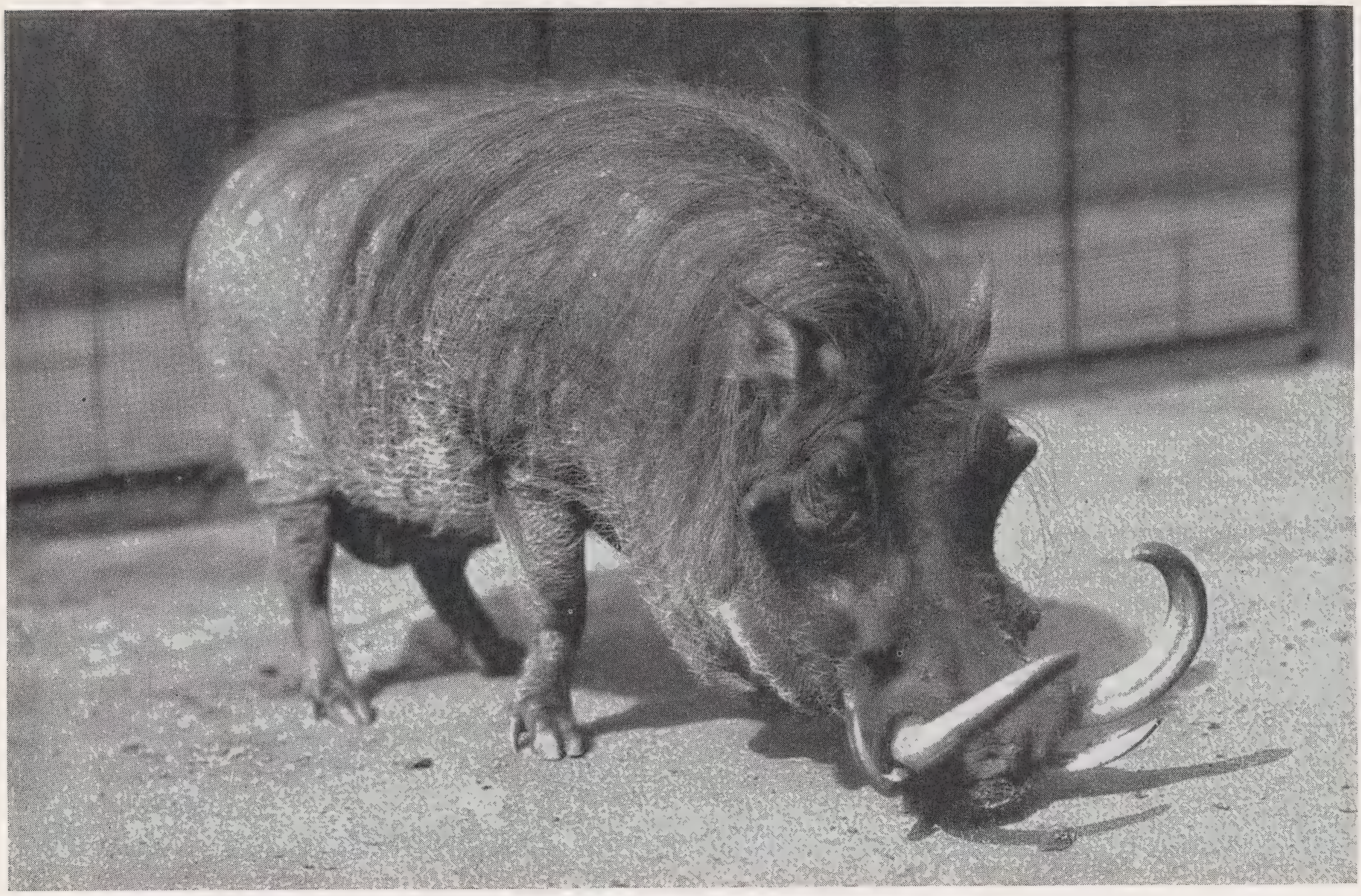
We have exhibited both the bush pig and the red river hog but the latter has not been represented for a number of years. Our present bush pig is a young male from Kenya.

WART HOG

Because of its grotesque appearance the wart hog receives first prize as being the most popular of all the pigs exhibited at the Zoological Park. More "whys" are asked concerning this animal than about all the rest of the wild swine. Public curiosity in this case is well founded for no other modern mammal is so strikingly blessed with what is generally referred to as "ugliness." The greatly enlarged head, much too large for the body, is embellished by two pairs of wart-like excrescences on the face and a long ridge-like expansion, bearing white whiskers, extends down the cheek to the mouth. The upper tusks are enlarged beyond all practical demands and curve upward and inward over the muzzle.

The warts have no connection with the skull structure itself and are composed entirely of cartilaginous material. Nature must have gone astray in creating them for they seem to be of no earthly use. Similarly, the great upper tusks, sometimes twenty inches or more in length, because of their exaggerated size and inwardly-curved dull points have lost much of their potential value as weapons. The sharply-pointed lower canines are about six inches in length. The edges are kept sharp by wearing against the upper tusks. These lower tusks are efficient weapons, respected even by the lion. Ordinarily, however, wart hogs are peaceful creatures.

The barrel-shaped body is sparsely covered with long coarse hair. The slender tail is terminated by a tassel of black hair. A rather amusing picture is presented when the animal is in flight, for at such times the tail is carried straight up, and the tassel may even fall forward. The legs are short but manage to propel



The wart hog has been called "the ugliest animal in the world," but this particular specimen has a gentle disposition that belies its appearance. In old animals the large upper tusks curve so far backward that they are not effective weapons, but the lower tusks are used.

the animal at good speed when necessity demands.

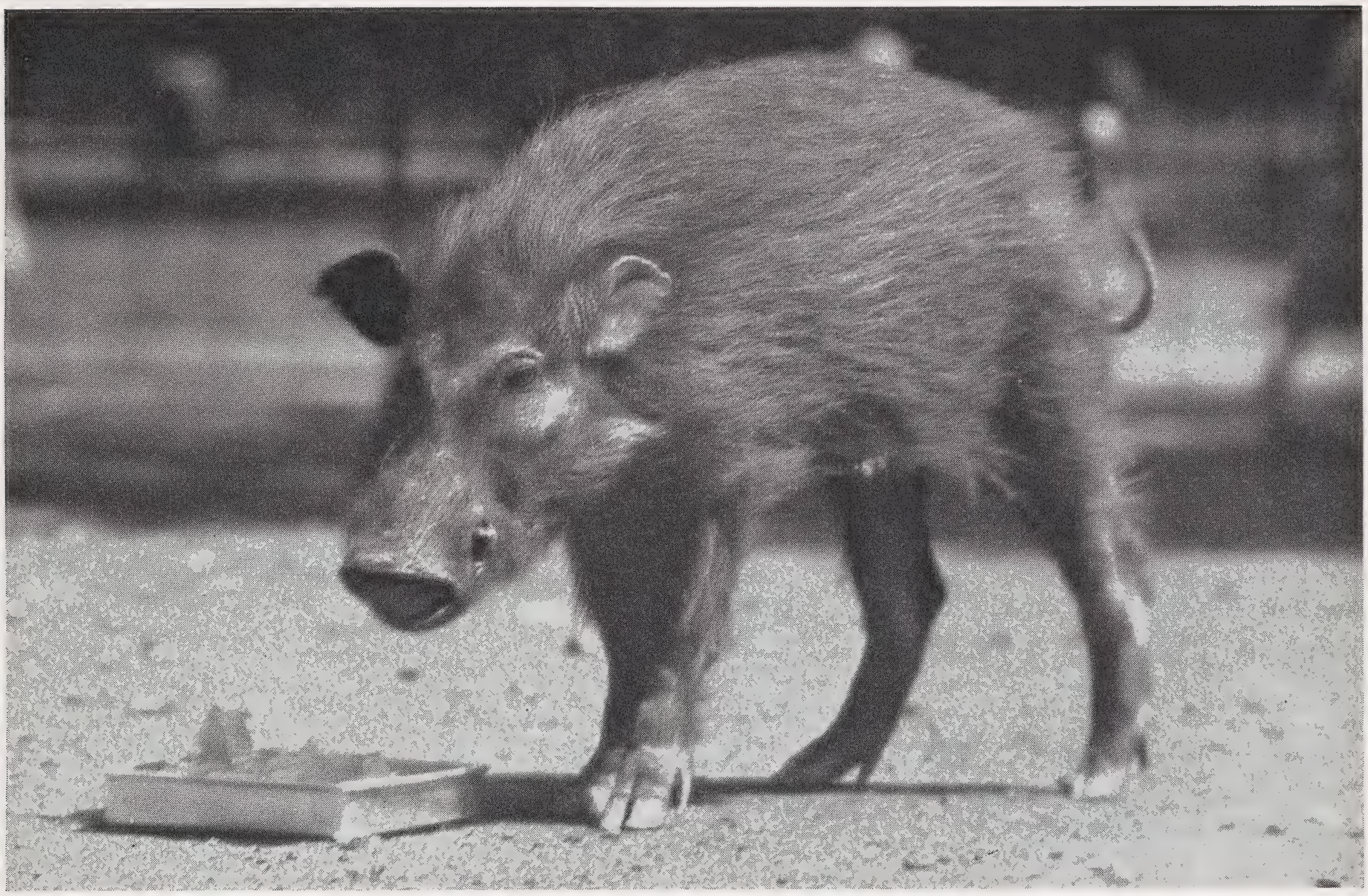
Unlike all other pigs, wart hogs are creatures of the plains and they are never found in thick forest. They are therefore better grazers than other pigs but they also root up the ground, sometimes getting down on their knees in order to make better progress. Apparently they indulge in this habit to a considerable extent, for the knees bear smooth, horny pads.

They live in burrows, sometimes of their own digging, and it is said that they always back into the burrow—the better to defend it against all comers. In this connection Col. Roosevelt makes an interesting statement in his "African Game Animals." He says that "No matter how headlong the speed of the hunted pig it will always turn and slip backward into its hole, with jack-in-the-box agility. Once we saw a young boar thus disappear, and immediately afterward reappear as if shot out of a catapult; evidently the burrow was already inhabited by another pig, which had savagely assailed the hind quarters of the intruder."

Wart hogs do well in captivity, and young pigs, which are entirely without spots or stripes, have been born in several Zoological Gardens. Our present specimen, "Clarence," has been in the Zoological Park since 1927. Failing eyesight and a touch of rheumatism, upon occasion, are the only apparent evidences of old age. He is an intelligent animal, greatly attached to his keepers. He never fails to respond to call and will travel the full length of his corral just to have his back scratched. Clarence detests the out-of-doors on a cloudy day. Sent to the corral during the clean-up period he persistently bumps the door with his snout until the keeper relents and allows him to come inside.

Forest Hog

In 1904 a large, forest-dwelling hog was discovered in the Mount Kenya region of East Africa. It was found to be more closely related to the wart hog than to the bush pig or *Sus.* Since it inhabits only high, forested areas it has been aptly named the forest hog and scientifically *Hylochoerus meinertzhageni,* in honor



The black-skinned, black-haired forest hog has been known to science only since 1904. *It is found in the high, forested regions of East Africa. Since it attains a size that entitles it to be called the largest of the wild swine, it is sometimes called the "giant forest hog."*

of its discoverer Lieutenant Meinertzhagen, of the East African Rifles, who obtained the first specimens for the British Museum.

The forest hog is uniformly black with the exception of some whitish hairs on the side of the head and on the belly. The hair is scanty and the black skin shows through. There is a shelf-like wart below the eye. In body weight this animal will probably average higher than any other wild pig.

Forest hogs keep strictly to forested areas, even to the upper limit of trees, and have never been known to make foraging expeditions on native crops. They are powerful diggers and turn up the forest floor in hay-cock-like piles. They are rather solitary in habits.

Babirusa

In many respects the babirusa (*Babirussa babyrussa*) of the Celebes and Boru is the most remarkable of our wild pigs. It is rather large, weighing about 200 pounds, and comes nearer to being hairless than any other wild swine. In old boars the tusks show a remarkable development. The upper pair, instead of growing normally from the side of the jaw, emerge from the top of the muzzle at about the middle, then curve, gradually and gracefully, upward and backward to meet the skull between the eyes. These tusks in old individuals are, therefore, utterly useless as weapons. The lower tusks are smaller and normally located but since they do not wear against the upper pair they are not kept sharp and serviceable as in other pigs. Since their growth is uninterrupted they become much like the upper pair.

In habits the babirusa in the wild differs little from other pigs. They travel in small herds and seem to prefer the vicinity of streams and rivers. They are excellent swimmers and are known to cross small channels separating one island from another. In spite of the fact that their ears are smaller than those of other pigs, their hearing is very acute.

In captivity our babirusa "Jimmy" is an intelligent and good-natured animal. Like our wart hog he responds readily to call and begs to have his back scratched. In the winter he sometimes becomes bored with inactivity and seeks the out-of-doors. With his snout, he lifts the latch on the door, thrusts his nose in the crack, pushes open the door and makes his way outside.

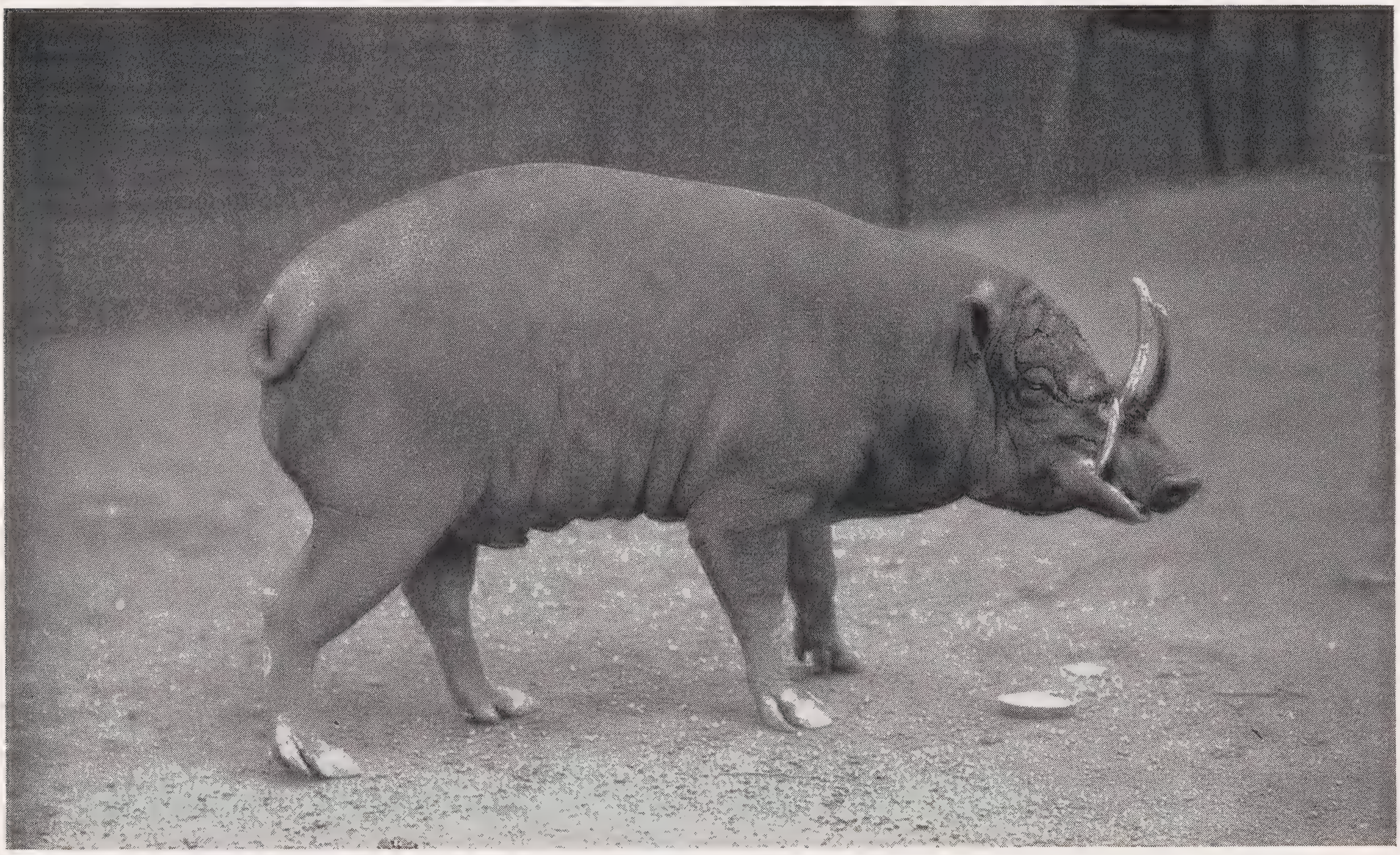
Domestic Swine

While the preceding material deals almost entirely with the pig in the wild, it seems worth while to discuss, briefly, how it has been changed by domestication and note its tremendous importance as a domestic animal.

As previously mentioned, the numerous breeds of domestic swine were apparently derived from whatever wild species happened to be near at hand. Thus we find, in the tens of thousands of years that have elapsed since the first half-wild swine were herded by our prehistoric ancestors, that most species, especially the European *Sus scrofa* and the Asiatic *Sus cristatus,* have contributed to the makeup of our man-made breeds. Such contributions are, of course, completely lost in antiquity, domestication extending back into prehistoric times. The Swiss Lake Dwellers had one and probably two distinct breeds, as evidenced by remains found in prehistoric dwelling sites. As for more modern civilizations, pigs have apparently been domesticated for a longer time in China than in any other country. It has been estimated that China possessed pigs as far back as 2900 B.C.

Various countries and regions of the world have produced their own particular types of hogs. Styles have changed considerably with the passing years and numerous breeds have been developed and discarded. Even today we find that different localities evidence a distinct preference for certain types and colors. Therefore, throughout the world there are many modern breeds and about twenty are popular in the United States alone. Color, rather than quality of flesh, seems to be an important factor in determining what breed of hogs is to be found in a given district. It is said that whites are most popular in Scotland and the north of England and blacks in southern England. The New York City market apparently demands white hogs, but a few years ago a census showed that the Berkshire, a black with white spots, was the most numerous in the state, and that the Duroc-Jersey, a red, was also extremely popular.

Time and demand have produced two main



The babirusa is the most nearly hairless of the wild pigs, but its chief characteristic is the upper tusks which, instead of emerging from the side of the jaw, protrude from the top at about the middle of the face. In old specimens they curve until they are useless as weapons.

types of hogs—a bacon type and a lard type. The latter is, of course, the heavier, and boars have weighed up to 1,000 lbs. Hogs of the bacon type are generally more rangy and not so heavy. Some of the American lard type breeds are the Berkshire, Poland China, Duroc-Jersey and the Jersey White. The large Yorkshire is the most popular bacon type.

Several of our modern American breeds have been developed in the United States. The oldest is the Chester White, developed from a pair of white hogs of Chinese ancestry which were imported to Chester County, Pennsylvania, about 1820. Another old and popular breed is the Duroc-Jersey, deep golden yellow to red in color. It dates back to about 1832, when Durocs, a New York state breed, were crossed with Jerseys, from New Jersey. It is believed that the foundation stock came originally from Spain, Portugal and Africa.

Hog raising and its resulting industries is certainly one of the world's big businesses. Statistics would indicate that more than a quarter of a billion hogs stock the world's farms—more than 37 million in the United States alone by the 1935 census. More animals are killed in a year than will show in a census since the life of an average pig is under a year. Considering that a sow can produce two litters of six pigs each, annually, and counting only a million hogs as breeding stock, we can easily realize the tremendous possibilities of annual production.

Principal Species and Races of Wild Swine
Comprising the Family *Suidae*

Sus scrofa scrofa	European wild boar.
S. s. attila	Hungarian and Russian race.
S. s. senaarensis	Senaar and Kordofan race.
S. s. lybicus	Asia Minor race.
S. s. moupinensis	Western China race.
S. s. nigripes	Tien Shan race.
S. c. cristatus	Indian wild boar.
S. c. gigas	Bornean giant wild boar.
S. leucomystax	Japanese wild boar.
S. vittatus	East Indian wild boar.
S. celebensis	Celebes to Philippines.
S. verrucosus	Warty pig. Java.
S. barbatus	Bearded pig. Borneo.
Porcula salvania	Pigmy hog. Sikhim, Nepal and Bhutan.
Koiropotamus k. koiropotamus	Bush pig. South and East Africa.
K. k. nyasae	Nyasaland race.
K. larvatus	Madagascar bush pig.
K. hassama	Abyssinian bush pig.
K. p. porcus	Red river hog. Upper Guinea.
K. porcus pictus	Camerun race.
K. p. ubangensis	North Congo race.
K. p. congicus	Lower Congo race.
Hylochoerus m. meinertzhageni	Forest hog. East Africa. Several local races can probably be recognized.
Phacochoerus a. aethiopicus	Wart hog. South and East Africa.
P. a. massaicus	Kilimanjaro race.
P. a. delamerei	North Somaliland race.
P. a. aeliani	Abyssinia race.
P. a. fossor	West Africa race.
P. a. africanus	Senegambia race.
Babirussa b. babyrussa	Babirusa. Boru.
B. b. celebensis	Celebes.

Baby Mermaid—a Manatee at the Aquarium

A Youngster from South America Contributes a Few Important Facts to Knowledge of Its Life and Habits

CHRISTOPHER W. COATES

"Could you not keep to the ocean that lulls the equator,
Soulless, immortal, and fatally fair to the gaze?
Or were you called to the north by an ecstacy greater
Than any you knew in those ancient and terrible days
When all your delight was to flash on the sight
Of the wondering sailor and lure him to death in the watery night?"*

THE classical mermaid is more beautiful than Badoura; a sort of combination of Aphrodite and Andromeda — the epitome of maidenly loveliness and gentleness — the unknowable and unidentifiable desire of all mankind, down to her waist. Below her waist she has glitter, grace, and power in her silvery-green fish tail.

The traditional position of such a creature is to be seated upon a wave-washed rock in the midst of a calm, intensely blue, tropic sea, and the traditional occupation is to comb her long golden hair the while she sings of the ineffable delights and felicities of the universe in a voice which might well be the envy of Euterpe.

If approached too closely by boisterous mankind, she modestly slid off her rock and as effortlessly as an eagle soaring, sought refuge in her father's palace at the bottom of the water, an abode which seems to have been uncomfortably cluttered with strings of pearls and red coral armchairs.

While such a concept can only exist in the minds of men who desire they know not what, one would be surprised at the number of people who ask Aquarium attendants, in all seriousness, where we keep the mermaid, and who are genuinely disappointed and sometimes indignant, when informed that these are mythical creatures.

There *is* some historical foundation for these mermaid myths—there are aquatic animals living in seas and rivers upon which imaginative men have erected these exquisite dream-beings. According to the locality in which the various myths originate, a definite species of animal may be involved, but no matter what the species, it is one of a group of five closely-related animals which have widely-scattered geographical distribution. These five, together with a sixth, make up the order Sirenia. The sixth species undoubtedly would have qualified had not its unknown habitat precluded all possibility of inclusion during the classical and myth-making times.

The Sirenia comprises three species of Dugongs and three species of Manatees, and while most of these creatures have been known to man since very ancient times, practically nothing whatever is known of their manner of living — much less, in fact, than has been written about the manner of living of a mermaid.

Last month the Aquarium had a mermaid—that is, it had a manatee. This manatee was of the sixth species, the species which had not been included in the group of mermaid-myth animals because its native area, and all the inhabitants thereof, were not only undiscovered, but were undreamed-of when the mermaid myths were in the making. If the following notes on this creature seem unnecessarily detailed, we ask indulgence and return to our statement that practically nothing is known of the living of these animals and it is only by the reporting of the minutiae of such behavior as may be observed that we ever will know anything of them. Brief and scattered notes on the ways of life of these animals are available, but they are sometimes contradictory and always scant and quite insufficient to form a clear picture of this strange group.

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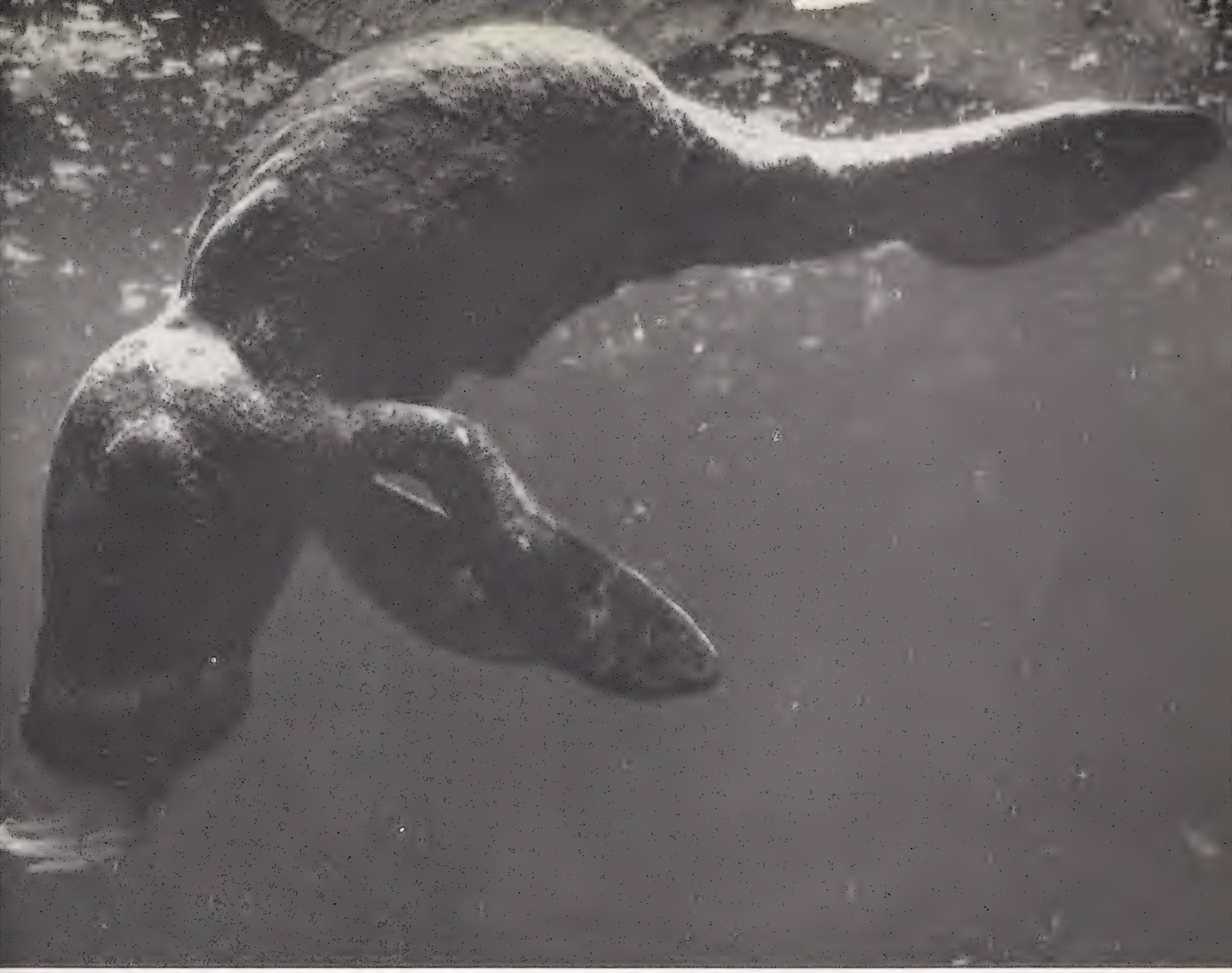
* From "Elegy On a Dead Mermaid Washed Ashore at Plymouth Rock." Reprinted from *The Collected Verse of Robert Hillyer*, by permission of and special arrangement with Alfred A. Knopf, Inc., authorized publishers.



In this curved, submerged, floating position the Aquarium's manatee spent the greater part of each day. From the surface it would drag down a piece of lettuce and slowly eat it under water, seemingly maintaining its static position by minute quiverings of its flippers.

The Aquarium mermaid was an immature Amazon manatee, *Trichechus inunguis* Natterer. It was a male, and while its overall length was about thirty-six inches and its weight about thirty pounds, we have no data at all on which to base an estimate of its age. It appeared to be quite young, though.

This species is rarely exhibited anywhere; a careful search of available notes and reports of the world's various zoological parks and aquaria, indicated that not more than six or eight of them have ever been captured successfully and shown in places distant from their waters of origin. These consist of most of the fresh-water systems of northeastern South America, and in some parts of this area the animal is relatively abundant and is hunted by the natives as a source of meat and oil.

Another species of manatee, a sea-going creature, sometimes is confused with the fresh-water manatee, for the sea-going creature is found along eastern coasts of the tropical Americas, including Florida, and even ascends rivers. A loose report to the effect that a manatee has been taken, say, from British Guiana, *might* indicate a fresh-water manatee, but from the size, behavior, and particularly the diet reported, the probability is that most of these are the salt-water creatures.

However, no manatee is particularly easy to catch alive, and for reasons which will be adduced later, they are difficult animals to transport and keep and, consequently, on which to assemble information.

The recent Aquarium manatee was caught and delivered to us by Paramount Aquarium, Inc., of New York, a firm of fish and animal collectors with stations all over the world.

We had requested this firm to procure a pair of these animals sometime ago, and word had been sent to all their stations in manatee country. However, none had been forthcoming.

Early this year, Mr. Marius Kramer, chief collector for the company, was starting on a tour of inspection of the Amazon stations and agreed to do what he could to catch our manatees for us. He knew that manatees were to be found up the Rio Tapajos, so when he arrived at Santarem, the base for this part of the country, he took Mr. Liebold, the station agent, and a collecting crew of natives up-stream. Distances in this part of the world are measured by days of travel, and when they were about ten days up the Tapajos they found our recent exhibit leisurely coasting along the shores of a small lagoon. It was secured by use of a large seine.

Hunting for a mate for it was commenced immediately, but Mr. Kramer had contracted a number of tropical diseases on the way up stream, and suddenly took a turn for the worse so that it became imperative to rush him off to hospital, about eighteen days away in Belem (Para). On this miserable trip, Mr. Kramer insisted that the manatee be brought along and saw to it that the beast had all the care and attention it needed until he was able to turn it over to Mr. Hora, manager of the Para station, in whose care it could safely await shipment to New York.

In Belem the manatee was kept in one of the company's pools in the gardens of the botanical and zoological park while a shipment of fishes and animals was being assembled and awaiting the arrival of an ocean fish transporter. Eventually the beast, along with about one hundred thousand other creatures, mostly small fishes, was placed in the fish rooms of the Booth-Mallory steamer *Crispin* for passage to New York. Mr. Reinhold Hawer was the runner in charge of this shipment.

Mr. Hawer has a long and extensive experience handling animals of all sorts in all parts of the world, and while he knew little, from first hand, of the difficulties of transporting manatees, he has an excellent animal sense. Accordingly, he put the creature into a box approximately ten feet long by four wide by three deep, about three-quarters filled with water. In such an excessively large box the little creature seemed lost, but there is an excellent reason for using so much water. These animals are mammals with a definite body temperature—almost one hundred degrees—to maintain. They live in water which constantly robs them of heat so that they are adapted to produce heat to compensate for this continuous loss. Consequently, if they are kept in a small quantity of water which is not continually changed, the water will become heated and perhaps "stew" the creature to death. We have no records of the amount of heat dissipated into water by a manatee, but we do have some records on porpoises, aquatic mammals which also never leave the water of their own volition as do seals and sea lions. In the case of porpoises we have found that an animal of medium size will raise the temperature of several hundred gallons of water twenty-five degrees in an hour. For this reason, then, Mr. Hawer provided the large box of water. Even so, he had to change and temper the fresh water several times a day—no light task at sea.

At the end of three weeks at sea, Mr. Hawer was exceedingly relieved to be able to turn the creature over to us, which he did on August 3, 1939.

All we had been able to learn of the diet of the manatee during its travels and stopovers was that it ate "salad." This, in tropical countries and at sea, may mean anything, but usually includes lettuce, so that in spite of the tiny amount of definite information available about these manatees, we had at least one lead as to its diet. If it had lived for several months with lettuce, it would probably live for a little while with us on the same diet while we looked about for something else for it to eat. However, it was reported by Mr. Hawer that he had heard in Para that the beast had not yet been weaned. Mr. Kramer was incommunicado in hospital so no information was forthcoming from him. Mr. Hawer had not given it any milk aboard ship. Although we considered for a while the possibility of offering it milk, we decided that even if it had not been weaned when it was caught, it had suffered a drastic weaning after capture and there was no use returning it to a milk diet. Consequently, lettuce was the order of the day.

The manatee took this somewhat languidly and a hurry call for other vegetables and fruits was sent out. However, although almost every kind of fruit and vegetable available through the market was tried, and such aquatic vegetation as we were able to collect ourselves, together with tropical lily pads, stalks, and blossoms kindly given to us by the Brooklyn Botanic Garden through the courtesy of Dr. George M. Reed, we found nothing that the beast would eat save an occasional handful of an alga, *Spirogyra.* It would eat a little of this one day, but not the next, so we were still looking for foods other than lettuce at the time the creature died.

In all the reports we have read on the feeding of these beasts we find unanimity in only one thing—bread. Manatees both free and captive are reported as eating bread freely, and one kept in this Aquarium twenty years ago ate one loaf of bread daily. However, this newest animal of ours was not interested in the least in bread, which disappointed us, for we thought that the amount of lettuce it took each day was incompatible with the amount of energy it used, and bread is much more substantial than lettuce leaves.

However, in this respect our ideas may not be much good, for almost all the Aquarium's charges are carnivorous and gulp down comparatively large quantities of concentrated proteins, while the manatee—all manatees are vegetarians — may extract much more nourishment from its "rabbit food" than we expect.

Some of the volunteer information we received following the publicity attending the arrival of the creature at the Aquarium indicated that (1) the manatee ate vegetation suspended above the water, (2) that the manatee ate vegetation anchored at the bottom of the water, (3) that the manatee ate vegetation floating at the surface. Since some of our visitors had been stationed in manatee country and appeared to be competent observers, we rigged up devices which would enable the creature to take food at any of these levels. It took it from the surface of the water, although it would occasionally root along the bottom. It would not reach above the surface even when it was hungry. The amount of food the animal ate is difficult to ascertain, for we followed the practice of keeping a plethora of fresh green lettuce leaves in the tank. Many of the leaves were partly chewed and then discarded, but we should estimate that between a quarter and a half a bushel was eaten daily.

Something else puzzled us about the beast's dietary habits. When it first arrived it appeared to be eating sand which it found at the bottom of the tank. There are all sorts of theoretical reasons why such an animal might eat sand, but none of them seemed to be quite valid, so topsoil mud was put into the tank as well as sand. Some of the mud was eaten immediately, which seems to bear out what has been reported—that it eats mud occasionally as an aid to elimination.

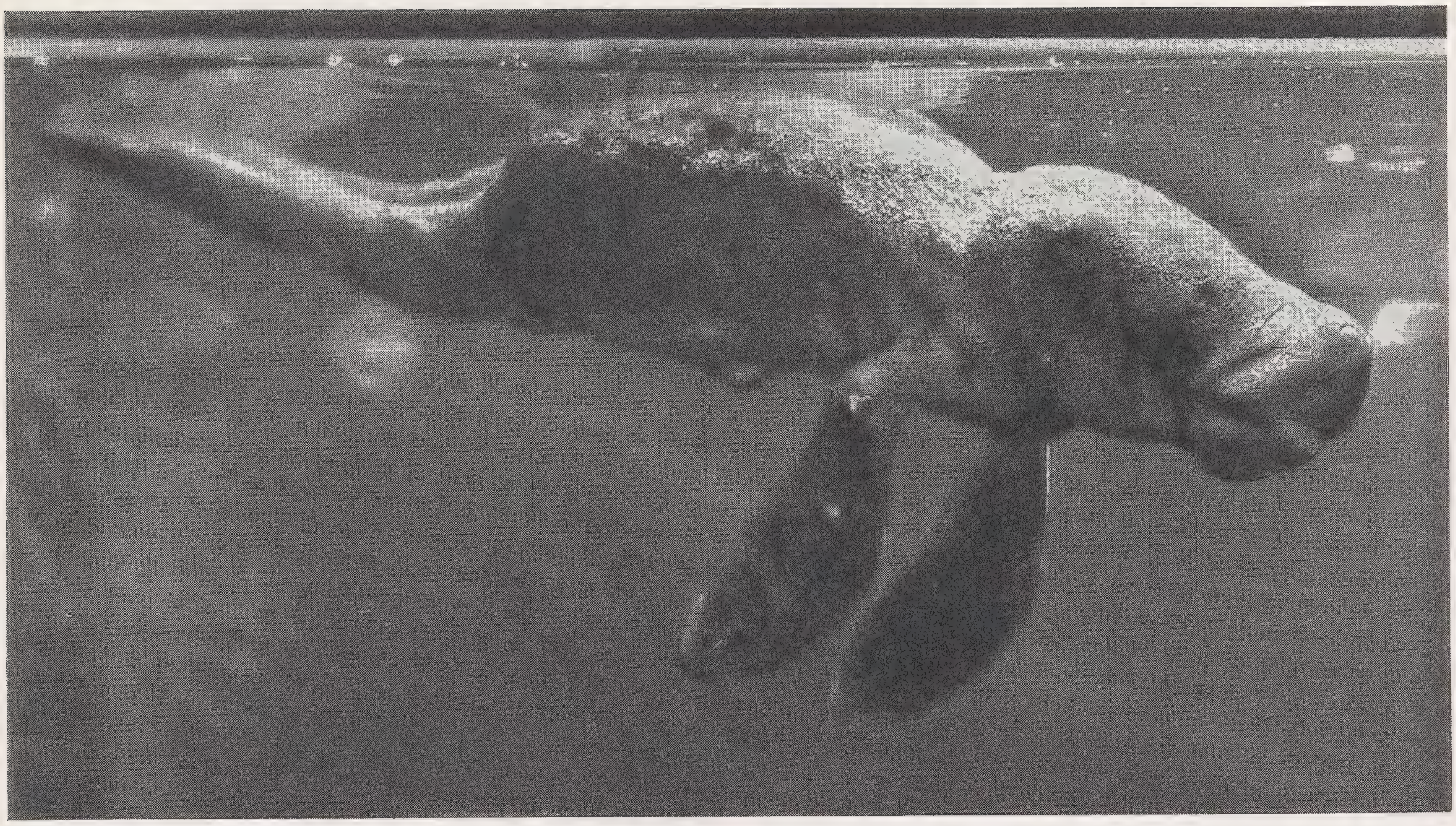
While we were looking for extra items of diet for the beast, we observed from its faeces evidence that it was getting plenty of nourishment and was in no danger of actual starvation.

The appropriate temperature at which the animal should be kept presented some problems.

Since it comes from the same waters as many of the small tropical fishes kept as domestic pets, we considered that water suitable in temperature for them would be suitable for it. This is about 78 degrees Fahrenheit. However, many reports we had gathered indicated that water cooler than this was most suitable. Our voluntary aid detachment again came to the fore in this respect and we were advised to keep the animal in waters with temperatures ranging from forty degrees to ninety degrees. What we did was to let the animal decide for itself which temperature it liked. We did this by putting two streams of water into the tank, at opposite corners, one running at seventy-eight degrees and the other at sixty-eight degrees. Without hesitation the animal selected the higher temperature. It was one of the few decisive things we ever saw it do.

However, even its decisiveness was alloyed on this score, for when the colder water was sprayed into the tank as rain, the beast swam over and "sat" under the cool rain. It did not remain there permanently, so the temperature of the tank was kept at seventy-eight degrees, within a degree or so one way or the other.

A further experiment was made to see if the manatee had any preference as to depth of water. The tank in which it lived, roughly eight feet wide by eleven feet long, had about four feet of water in it. A sort of platform of roughly-trimmed logs was built across the tank, rising from the floor and reaching the surface of the water on the opposite side. The angle was about 30 degrees and the idea was that if the beast had any particular preference, it



A side view of the manatee as it cruised across its tank. The animal's right eye can be seen as a dark spot about three-quarters of an inch back from the end of the snout. The pebbled appearance of the skin is caused by small bubbles which clung to it as the manatee submerged

would indicate it by resting at the chosen level. However, with the exception of two or three observations in more than two weeks, it always floated free in the deepest part of the tank and apparently did not care what the depth of water was. Toward the end of its stay with us it seemed to use the logs more frequently, floating above them and holding one between the tips of its flippers.

As a matter of fact, the manatee seemed to prefer the deep part of the tank next to the glass front most of the day, which was fortunate for our visitors, for without any forcing at all it stayed in full view of the spectators practically all the time.

The general behavior of our "mermaid" was lackadaisical in the extreme. Its normal position somewhat resembled an angular parabola, if there is such a thing, the head and tail being held downward in the water with the back up. The comparatively enormous lungs filled with air probably cause this position. Whether the manatee was floating at the surface, resting on its flippers at the bottom, or floating midway between bottom and top of the water, the posture of the body was the same except when it made an effort to catch a bit of food floating at the surface or when it was breathing.

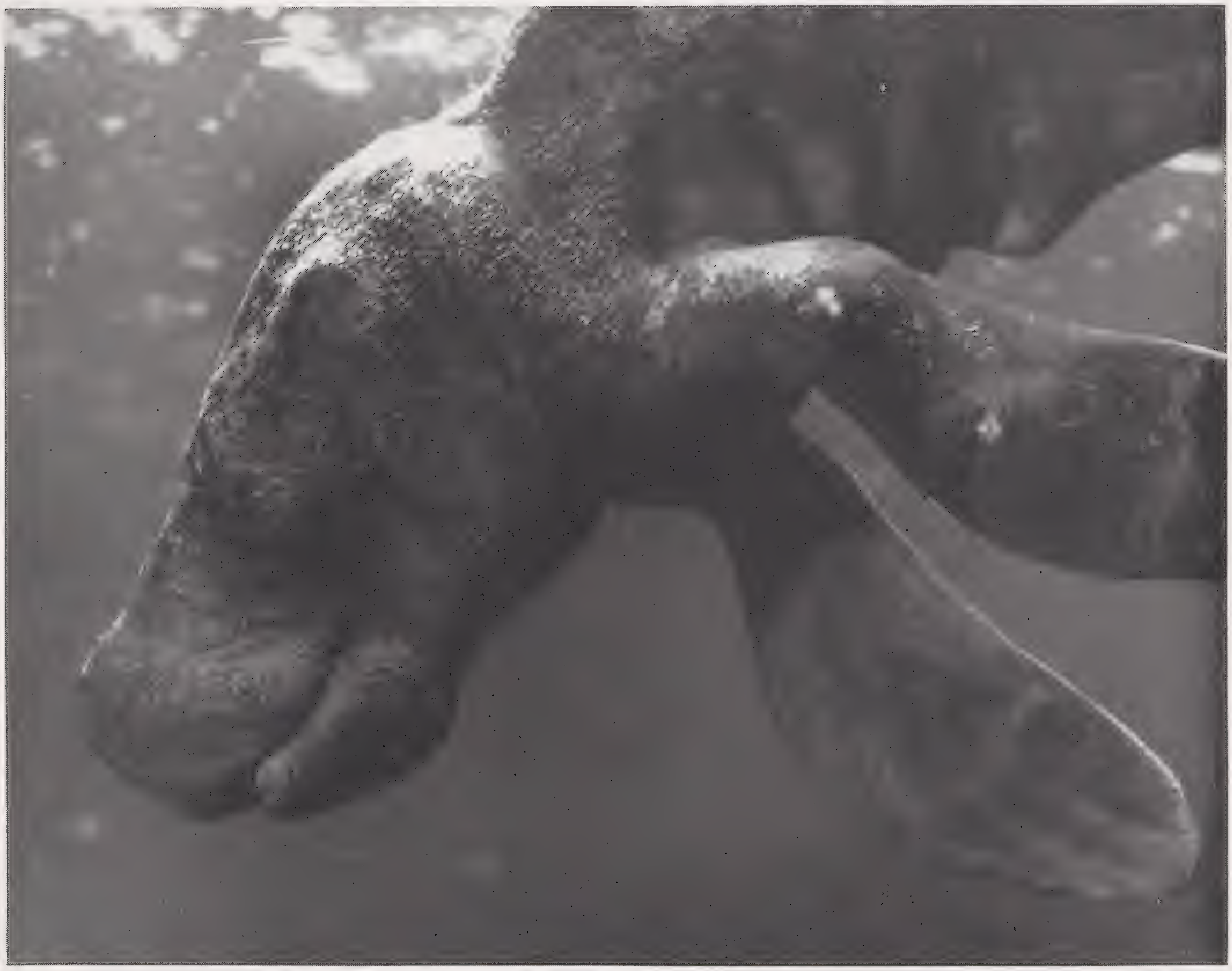
The flippers were usually hanging limply downward, frequently quite still and at other times with the smallest of quiverings. This resembled shivering and it was reported to us several times that the beast was shivering with cold. It may have been shivering, although we doubt the cold. We did find that if the beast floated without quivers it would be carried along by the gentle current of water in the tank, whereas, when the flippers quivered, the manatee remained in one position. The quivering, then, appeared to be some sort of minor locomotive effort. This is exactly the same as the "finning" of fishes, a method of locomotion used to maintain a definite position in respect to a fixed object and not in relation to a flowing current of water, and shows how completely adapted to a totally aquatic environment a mammal may become.

Long resting periods occurred throughout the day. They certainly occurred during the night, but we did not find out if the beast actually slept. The eyes were tiny, not more than one-eighth of an inch wide by three-sixteenths long, and while they were shiny black, when one could see them, it was usually impossible to note whether they were closed or open at any time. We observed that the creature rose to breathe as frequently as four times in one minute when it was feeding. On one occasion during the night, it did not raise its head to breathe for a little longer than fourteen minutes. However, not more than two or three minutes elapsed between breaths during daylight hours, and between four and nine minutes during the night, as a rule. The fourteen-minute observation was made while the creature was floating about two feet below the surface and about one foot above the bottom of the tank, when it was hanging in mid-water as if suspended by a cord.

It was an extremely mild-mannered beast, taking food from our hands in less than two days after arrival. Its snout was soft, comparable to the lips of a horse, and if it sucked in a finger occasionally, it did not bite at all. It had no front teeth, but did have molars, the exact number being unascertainable in life. It is a matter of record that the number of these chewing teeth varies considerably. Apparently there is a constant supply of new ones coming from the back to take the place of old ones which are worn out.

The lips were flexible and equipped with a relatively heavy growth of bristles. These seemed to be used to help the lips work food into the mouth, which usually exposed a grayish mass of gum-like tissue.

The nostrils were large and at the top of the snout. They were marked by the grayish crescent at the edges of the flaps which were automatically closed while the creature was below water. When it breathed, these were pulled



A close-up picture of the manatee's head shows the large, soft snout and the rather prominent cranial bump, near the rear top of the skull, which at first glance seems to be the animal's eye. The actual eye is so small, however, that it is scarcely visible here.

open, and if the creature was disturbed while breathing, and shut them quickly, a distinctly audible snap was heard.

The ears were not visible at all. They are reported as being nothing more than tiny slits at the best of times, but while it was alive we did not see even slits in our beast.

In general, the appearance of the creature was like nothing one could possibly imagine. The head was shaped roughly like that of a hippopotamus, the neck was non-existent, but there was a crease in the skin where the neck might be supposed to be. The body was somewhat egg-shaped, and not more than half as big again as the head. The tail was a flat paddle, round at the end, and strongly ridged, with the edges turned downward. This paddle looked as if a strong rigid tail had been forced downward, the hind legs forced backward and upward, and a flattish rubber container slipped over all three members.

In color the beast was a dull, lead gray, sparsely bristled, and the general appearance was as far from prepossessing as it well could be. It is difficult to conceive that this or any of its relatives could ever have possibly suggested a mermaid. Apologists for the mermaid myths tell us that if such an animal is viewed from a distance as it sits high out of the water against the rays of the setting sun, the lines of the head flowing into those of the body may suggest flowing locks. The ineffectual scratchings of its head with the flippers may suggest combing of these same locks, and the lack of reflected light from the face prevents the features being distinguished. Consequently, the mermaid. However, not by any stretch of our imagination could we translate any of our manatee's activities, or its appearance, into those of a mermaid, or of any other kind of maid whatever.

Of course all such ideas are entirely subjective and it may be that other persons can imagine more vividly than we.

Until comparatively recent days, naturalists were disposed to lump all the aquatic mammals together, throwing into one group the whales, porpoises, seals, sea lions, walruses, dugongs, manatees and any other mammal which was originally a terrestrial creature but which went back to water to live permanently. More recent investigations, however, have disclosed that while all these creatures are descendants of land-living animals which went back to water, they are descended from entirely different stocks, the seals, sea lions and their relatives originating in carnivores, and the rest in herbivores. It was thought for a while that the whales and similar creatures were branches of the same stem as the dugongs and manatees, but again these have been found to have different origins, although they are all descended from ungulates, the hoofed mammals.

The order Sirenia is confined to the warmer waters of the globe, covering both eastern and western hemispheres. The dugongs inhabit the waters of the eastern world while the manatees are specifically of the western ocean or its contributing streams.

The dugongs, originally considered one species, have been divided into three, and the manatees, in which we are more interested at the moment, have been recognized as of three full species. These are *Trichechus manatus manatus* L. of the West Indies, the borders of the Caribbean Sea and the coast and lower reaches of the rivers of northeastern South America. A second sub-species of the species *T. manatus* is *T. manatus latirostris* (Harlan) of the coast and coastal rivers of the United States from Beaufort, N. C., to the Florida Keys and the coasts of the Gulf of Mexico. A second full species, *Trichechus senegalensis* Link, lives on the west coast of Africa, going some little way up the rivers from the Senegal to the Quanza, up the Niger, and probably into the Lake Chad drainage. This species has also been found, occasionally, around the southern tip of Africa and a little way up the east coast. The last species, *Trichechus inunguis* Natterer, is the one represented by the animal recently shown in the Aquarium. The range of this species includes probably all of the rivers of northeastern South America, and particularly the Amazon and Orinoco systems. This is the only species which does not enter the sea, staying far out of reach of tide water.

All of these beasts have undergone considerable modification since they took to the water. They have, for instance, lost their hind legs, only the merest traces of the pelvic girdle remaining.

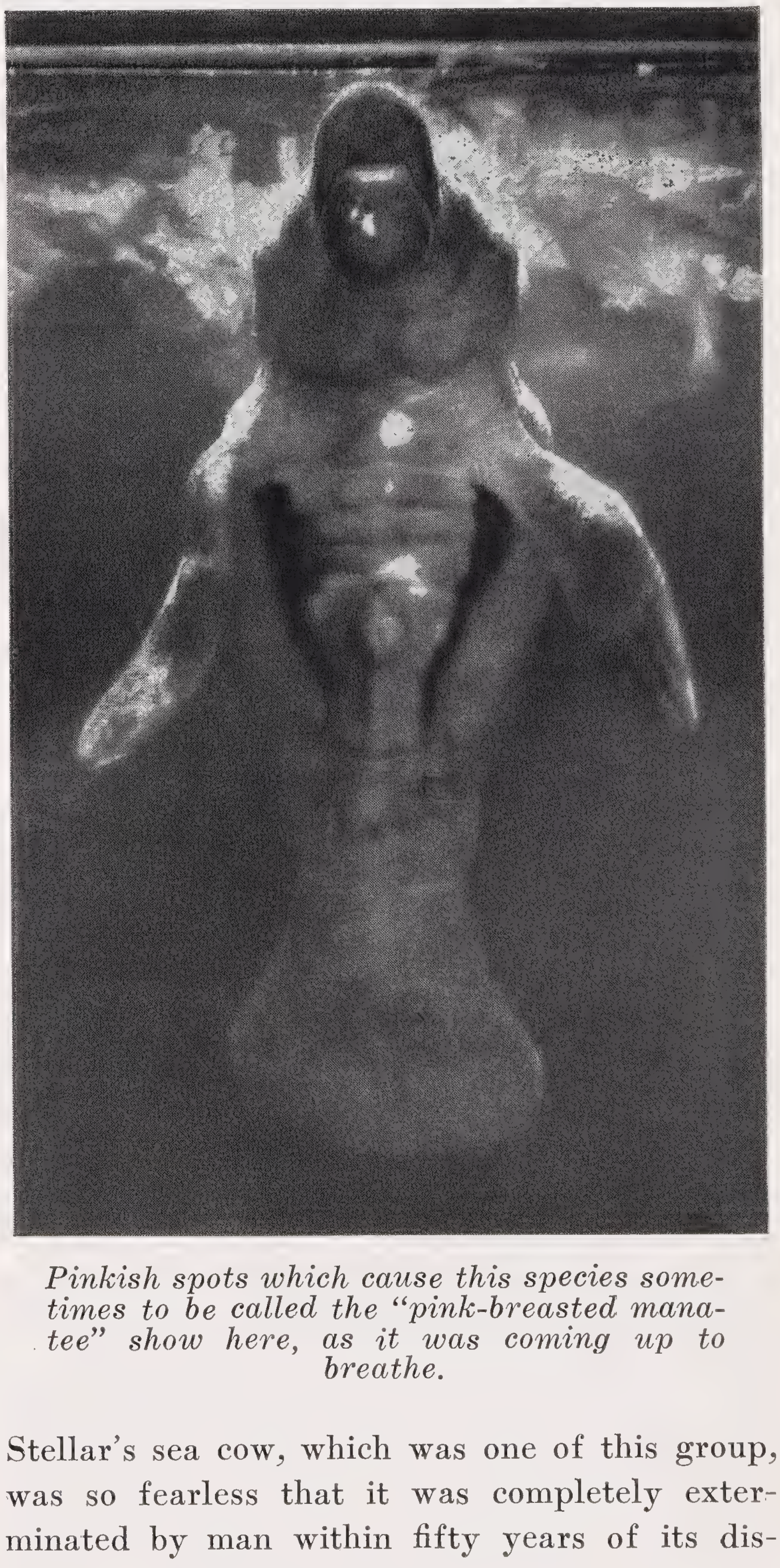
The forelegs, although they retain all the articulations in the bony structure of any mammal—even the phalanges of the "fingers" are still there—are enclosed in a fold of skin to make a paddle or flipper. In the Amazon manatee, none of the nails of the fore-toes is visible; in the others these still show external traces. This flipper does not seem to have any great power, and is not nearly as strongly developed as the same limbs in either whales or seals, for instance. They do show some ability to move the animal against flowing water, as we said earlier, and occasionally our creature was observed "walking" along the bottom of the tank, the body held off the floor and the tips of the flippers turned inward exactly as if we walked on our outstretched arms with the last joint of our fingers turned inward.

The bony structure is exceedingly solid and heavy enough to act as ballast in the water, buoyancy being given, in all probability, by the lungs. That this may be adjusted to an extremely fine point is witnessed by the way in which our beast could remain at any level in the water without visible support of any nature.

There has been considerable discussion of the various senses of the animals, certain structures of the nerves indicating that the sense of smell might be degenerating, and observations in life seem to indicate that there is little, if any, sense of smell. Our own observations do not throw much light on this subject, for the beast seemed to have no difficulty locating bits of lettuce either above, beneath, or upon the surface of the water. The small eyes, however, and the nature of the water in its native streams, which must certainly be roiled considerably at times, would indicate that this species, in common with other aquatic animals from the same general locality, certainly does not depend to any great extent upon vision. Articles waved about the head of our beast, within a few inches of its eyes and nose, did not cause any particularly active movement, but the slightest touch on the body, and especially the tail, would send it scuttering off at great speed.

Incidentally, we have pondered much about the speed of the creature. There is irrefutable evidence that these animals have existed for many thousands, possibly millions of years. They live, without exception, where there are formidable predators. They have absolutely no offensive or defensive weapons, and apparently are not particularly vigilant.

They have, nevertheless, persisted in spite of the lack of fang or claw or other defensive mechanism. Verbal reports to the effect that a disturbed manatee can make off at a much greater speed than could be mustered by any crocodilian, for instance, may account for their survival, but there may be some other agent of which we have no comprehension. Certainly Stellar's sea cow, which was one of this group, was so fearless that it was completely exterminated by man within fifty years of its discovery in the North Pacific.



Pinkish spots which cause this species sometimes to be called the "pink-breasted manatee" show here, as it was coming up to breathe.

Man, in fact, seems to be the manatee's only active enemy, for the Florida manatee, once abundant, is in danger of extinction since white men came with their guns. This species is protected by law, and although we have been offered one or two from time to time, have preferred to leave them where they are and thus do our small part in their preservation. The Amazon manatee, however, seems to be in no danger of extinction, although several native methods of hunting it are recorded. The fact that the Church in South America ruled that since these creatures came out of the water they could be considered as fish did not do them any good, for the meat is reported as excellent, tasting like something between pork and beef, and Catholics in those areas can safely eat such meat without incurring disfavor. Nevertheless, various reports on the catching of the beasts, and comments on the same indicate that we need not expect any serious danger of extinction from this score, for the methods necessary to catch them make all but the hardiest hunters hesitate. One method reported is to harpoon the creature, whereupon it makes off at top speed, towing as many as six canoes after it. This might be quite all right, and even might be considered as good sport were not the waters infested with caimans and the danger of an upset canoe extremely great.

Another practice of somewhat recent origin is for two hunters to attack the same beast simultaneously. The first uses a harpoon and line to keep the animal where it may be reached—manatees invariably sink when they are killed and may be lost—and the other a gun of some sort. Both harpoon and gun are discharged into the animal at the same time.

Still another method is to locate a manatee in a small stream or lagoon and then stretch a strong net across the outlet. The beast is then frightened until it makes for deeper water, running into the net and being entangled therein.

All of these methods are those employed in hunting the Amazon manatee which is relatively small. Its size is reported at about six feet as a maximum, with a weight of six or seven hundred pounds. The manatees which go into salt water are reported as much larger—fourteen feet long and a weight of more than half a ton is recorded.

There is a brief record of a Florida manatee bearing a calf in captivity in Miami, Florida. At birth, the calf weighed more than sixty pounds, and was longer than our recent acquisition. It was born in the water. Both male and female of the pair were together at the time and were reported to have taken turns holding the infant out of water in their flippers. In fact they held the creature out of water so much that it was found necessary to remove the male from the enclosure. There are no such records for the Amazon species. However, this is one of the things which gets in the way of a wholehearted belief in mermaids. The fact that the female holds the calf's head out of water as it suckles at her breasts, which are high on the chest, is adduced as additional evidence for the existence of mermaids, but a nursing mother does not quite fit into the classic picture of such creatures. Anyway, the statement that the female holds the infant at all has been controverted, purely on anatomical grounds. The flippers are supposedly not long enough or strong enough to hold the young, according to anatomists, and in the case of the dugong, at least, the calf rides on the mother's back, according to observations made in a German zoo. If we ever receive a pair of manatees, and if they ever mate and raise a family, we will know more about this aspect of these queer animals. The concensus of opinion is that one calf is born at a time, although twins have been doubtfully reported.

Our latest manatee died during the morning of August 25, twenty-two days after it was received. A thorough examination of the body was made by Mr. H. C. Raven, Prosector of the Society. His report indicates that the organs were in good condition; that the animal had been eating and was sufficiently fat; and that deep-seated ulcers found in the muscles of the back were the probable cause of death. There was no external manifestation of these ulcers, which were certainly not of recent origin. There was no trace of any foreign body in the necrotic area so that its cause is problematical. We are informed, however, that similar conditions are not uncommonly found in mammals taken wild.

The photographs illustrating this article were taken at the Aquarium by S. C. Dunton.

Zoology Goes to the World's Fair

Both the Visitors and the Society Learn Much Through the Medium of Our Exhibition Building on Flushing Meadows

William Bridges

IT is 9:30 o'clock on a fine autumn morning and the staff of the Zoological Society's building at the World's Fair is going about the business of getting ready to open. Brushing off the sidewalk, uncovering the turnstile, bustling about with brooms and feeding pans and dustcloths.

The ticket-seller in her booth is checking yesterday's accounts when a boy detaches himself from the crowd pouring off the Eighth Avenue subway ramp and approaches the booth with a purposeful air. He slides a quarter through the window.

"The building isn't open yet. It opens at ten."

"I know, but I might spend all my money today, and I want to see the panda tonight. I'll buy a ticket now and use it tonight."

I happened to overhear the conversation and I took good note of the lad. Sure enough, he presented his prudently purchased ticket a little after 9 o'clock that evening and he was still whooping with laughter at Pandora's antics when I left the building at 11 o'clock.

Pandora, it seems, casts a spell over everybody who sees her, so that by word-of-mouth the news has gotten around among visitors to the World's Fair that one sight that mustn't be missed is the giant panda. In no other way can the steadily increasing attendance at the Society's exhibit be satisfactorily explained.

And it is Pandora—strongly aided by the Aquarium's electric eel, which is also an attraction of real magnitude—that explains the number of "repeat" visitors. There is no way of determining their proportion among the total number of visitors, but long ago the staff ceased to be surprised when someone remarked, "This is the third (or the fourth, or the sixth) time I've come in here, and Pandora's always up to something new."

For Pandora, of course, generally *is* up to something new—some hitherto undiscovered way of climbing her cage-tree upside down or of eating an orange while virtually sitting on her own neck. Her tricks are spontaneous and unpredictable and without any coaxing on the part of her keeper she launches whole gales of laughter from her audience.

Now that the 1939 World's Fair is nearing its end, a few general conclusions can be drawn from the experiences of the summer. The avidity with which our visitors take to zoological information and the wide range of the questions they ask attendants is a very important indication of the kind of teaching the Zoological Park and the Aquarium can do. To perform this effectively, both institutions would, of course, have to instal a docent service, to correspond to the attendants who were constantly on the floor of the World's Fair building and usually spent the entire day answering questions and giving brief talks about the exhibits. It was noticeable, too, that a majority of visitors were interested in the details of the displays; many of them have been observed going through the building systematically and reading every label—and frequently asking attendants for more information.

It must be admitted that some few visitors failed to absorb all of the knowledge that was placed before them. That came out in rather startling form after a large and supposedly clearly-worded panel was placed on the wall at the end of Pandora's compartment. The sign read:

"Pandora was called the Flying Baby Panda when she came to the New York Zoological

Park in 1938. She flew from the interior of China to the coast, crossed the Pacific by steamer, and flew across the United States. She weighed 35 pounds when she arrived and will weigh 200 or more when adult. Pandora loves almost all vegetables and 25 separate items, ranging from baked potato to iron salts, are on her daily menu."

The first day that the panel was in place, an attendant was stopped by a couple standing at the rail watching the panda.

"Where's the panda's wings?" one of them asked.

"Wings?"

"Yes, you know; how does it fly?"

"But it doesn't fly!"

"Why . . . the sign says it does. It says something about the baby flying panda . . ."

On another occasion an attendant overheard a young man discussing the matter of panda flight with a girl.

"They don't have real wings, like a bird," he said authoritatively. "It's more like a flying squirrel, you know. They climb trees and take long jumps and kind of soar."

Certainly equally confused—and just as positive—was one visitor who hunted up Pandora's keeper and denounced the animal as a fake.

"That's no animal!" he exclaimed. "That's a man dressed up in some kind of a skin!"

In the subsequent argument, it came out that the visitor's reasons for believing that Pandora was masquerading as an animal were that her antics were too funny to be real, and that she seemed to be making a conscious effort to entertain the crowd.

"Look, you can't tell me that a dumb animal watches a crowd and knows what makes them laugh, and then does it again to get another laugh," the visitor insisted.

He left the building finally, still apparently unconvinced that there was no deception about the panda.

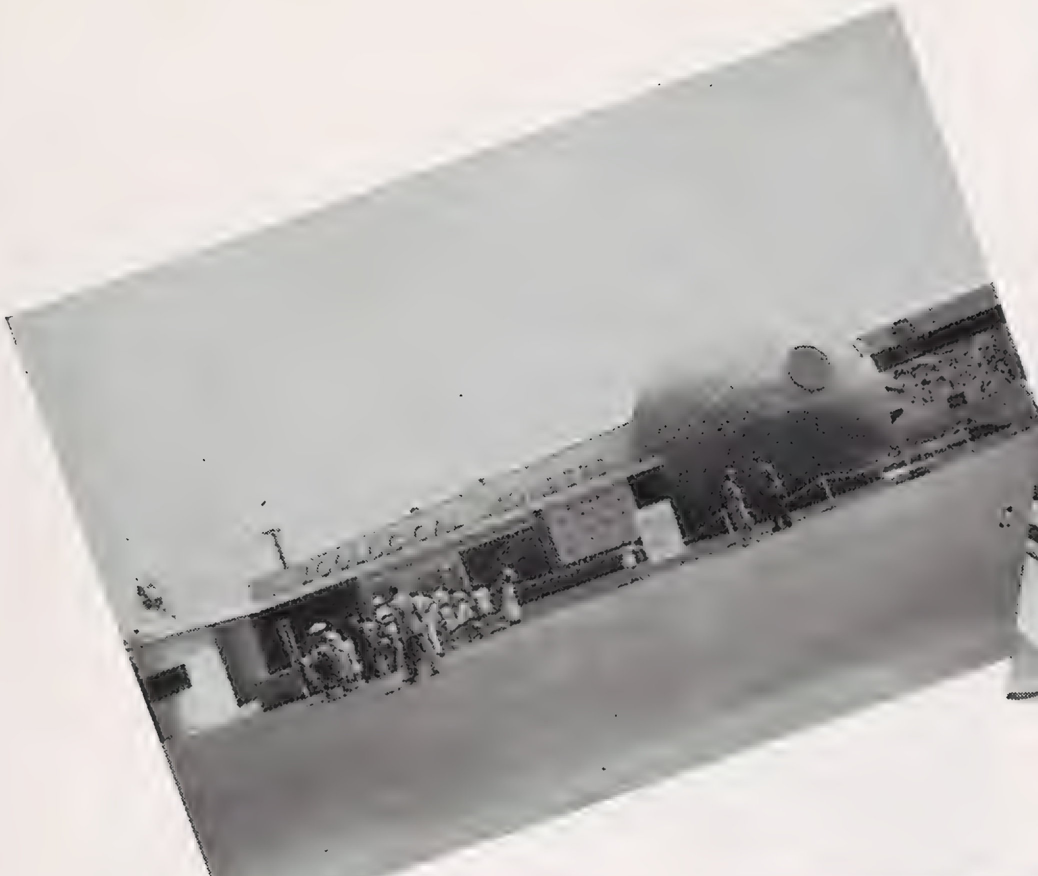
The visitors who four times each hour watch a demonstration of the electrical powers of the electric eel have also produced a few sceptics, although the businesslike array of electrical apparatus connected with the eel's tank has served to impress most of them. Of more frequent occurrence are the amateur electricians—and occasionally professionals—who shoot difficult and technical questions at the demonstrator. The commonest question, "How does it make electricity?" is one that nobody has been able to answer with complete satisfaction—not even the investigators at the Aquarium who have been pursuing research on the electric eel for several years.

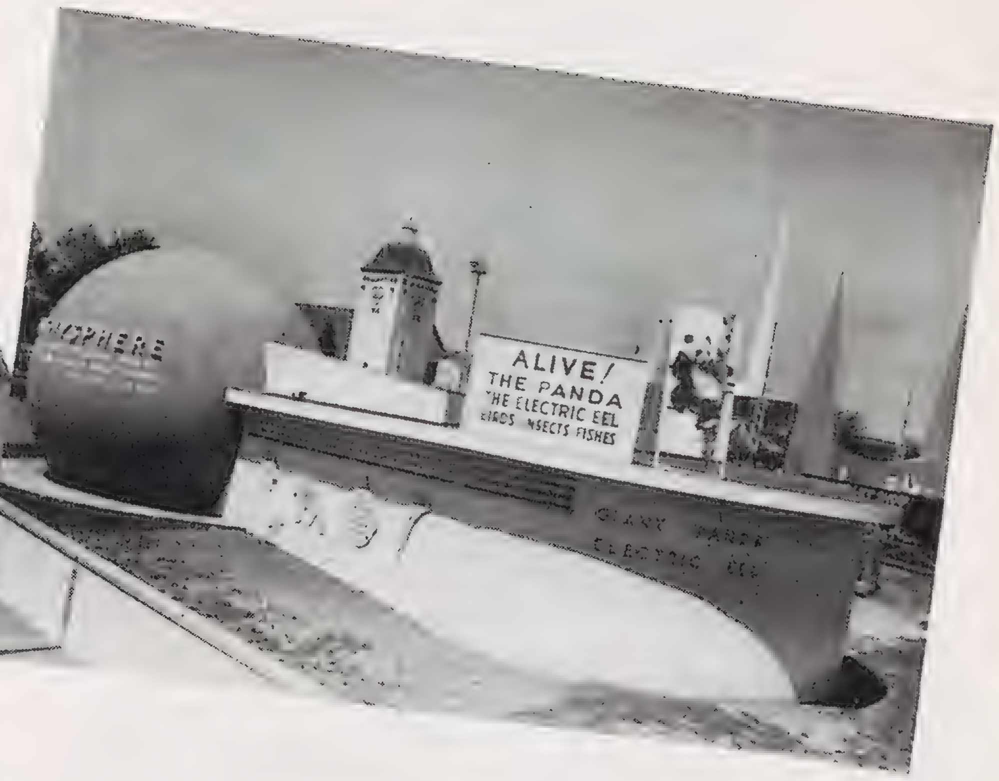
With less instrinsic charm than the panda, the electric eel nevertheless has been able to arouse real enthusiasm in many visitors. One woman told the demonstrator that she had seen the eel's performance six times and that she had made up her mind to come to the World's Fair when she read, in a Utah newspaper, that one of the exhibits was a fish that could make electricity.

The eel's most faithful "fan," however, is probably the little boy whose mother beckoned an attendant outside the building one afternoon about 5 o'clock.

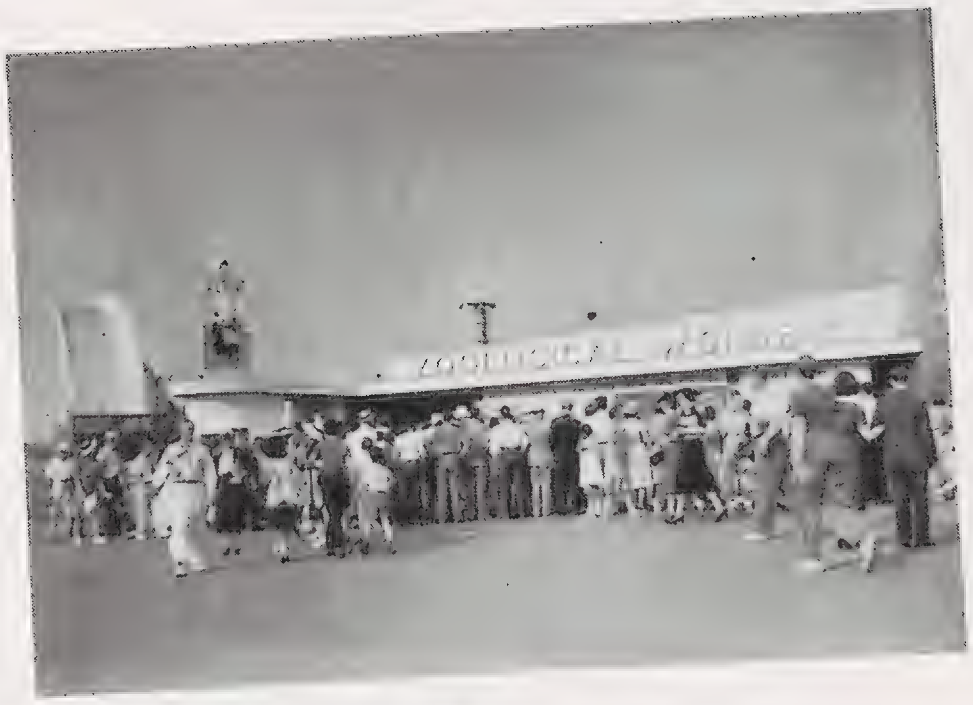
"Would you mind going around to the electric eel exhibit and getting the little boy in the red sweater?" she asked. "It's my son—I left him here at 1 o'clock and he said I could call for him after the 6 o'clock demonstration, but I'd like to go home a little early. He won't want to leave, but you tell him mother said he's seen enough eel demonstration for today!"

The pictures on the following three pages are random scenes outside and inside the Society's building at the Fair. Many of the exhibits, notably the "Crown Jewels"—brilliantly colored birds and fishes—and the mangrove habitat display of the Aquarium, are not pictured.





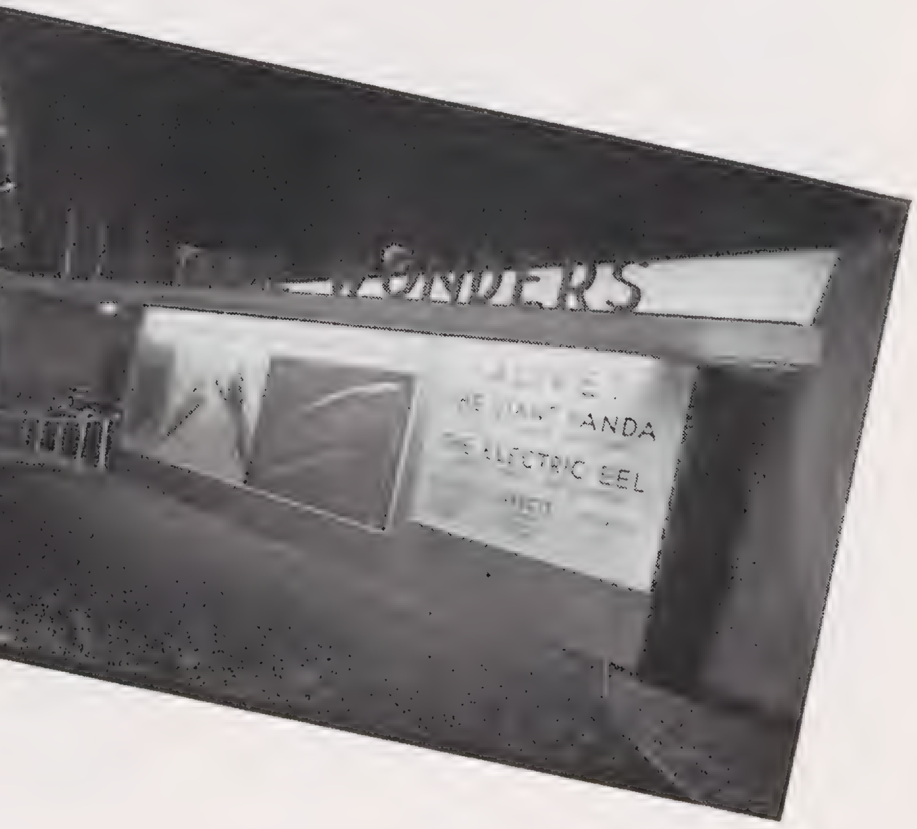
Above: *The low, flat form of the Society's building at the World's Fair is dominated by the representation of the Bathysphere.* Right: *Crowds throng to the front of the building as soon as the demonstrator begins to talk about the exhibits to be seen inside.*

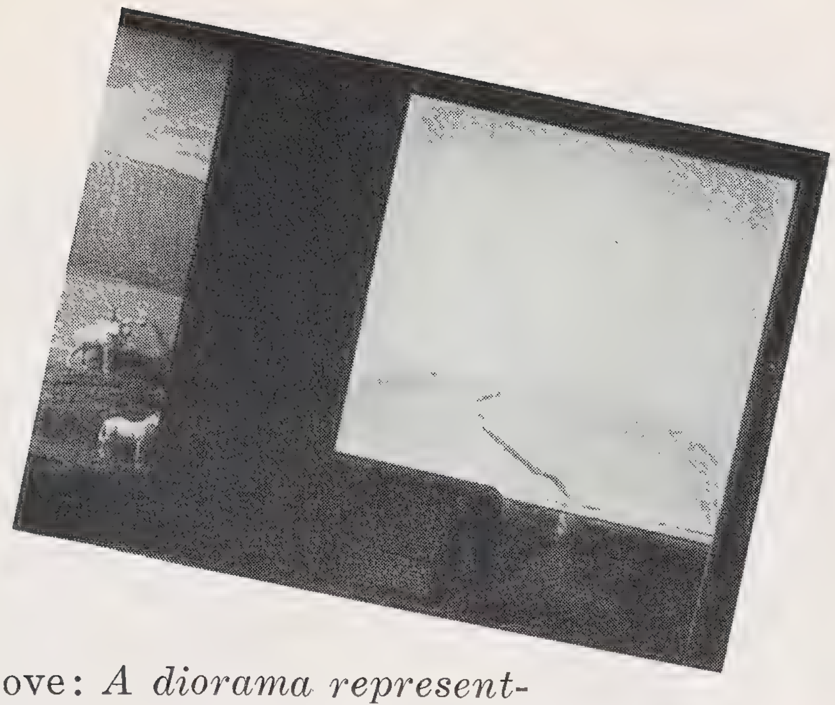


Above: *The building stands directly alongside the ramp leading to the Eighth Avenue subway, down which thousands of visitors pour into the Fair daily. This shows the rear of the building as seen from the ramp, with attractive announcements of the wonders within.*

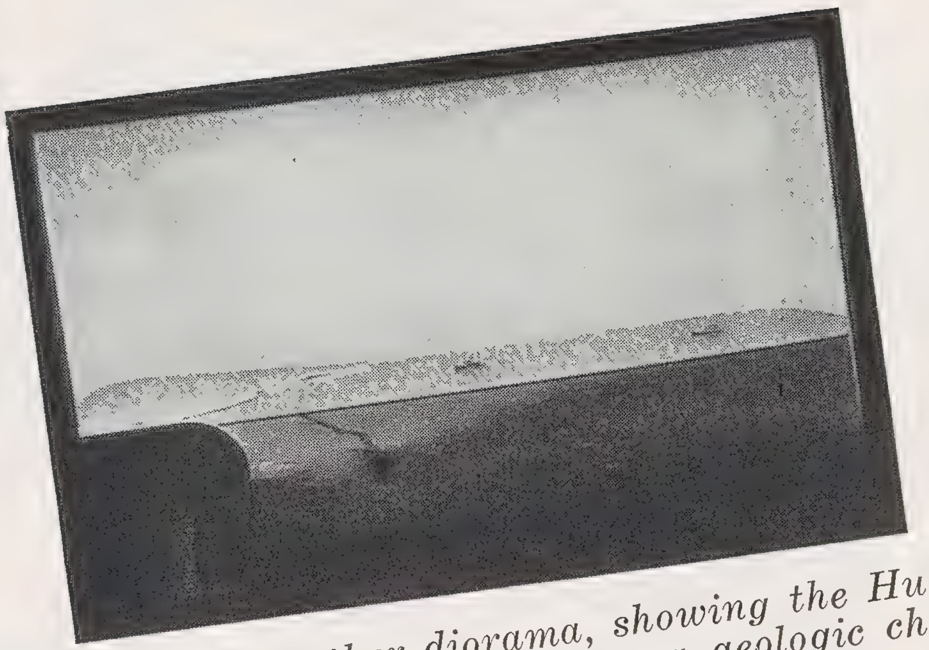
Below: *Gigantic photo-murals occupy most of the front wall of the building, and at night these are brightly illuminated. The murals picture a few of the exhibits, such as the seahorse, praying mantis from the insect collection, tree kangaroo and electric eel.*

Above: *A most effective aid to the demonstrator is "Jimmy," the kinkajou, which sleeps on a perch under the umbrella most of the day but awakens periodically to receive the applause of the audience. "Jimmy's" only rival is a horned toad, sometimes used by the speaker.*

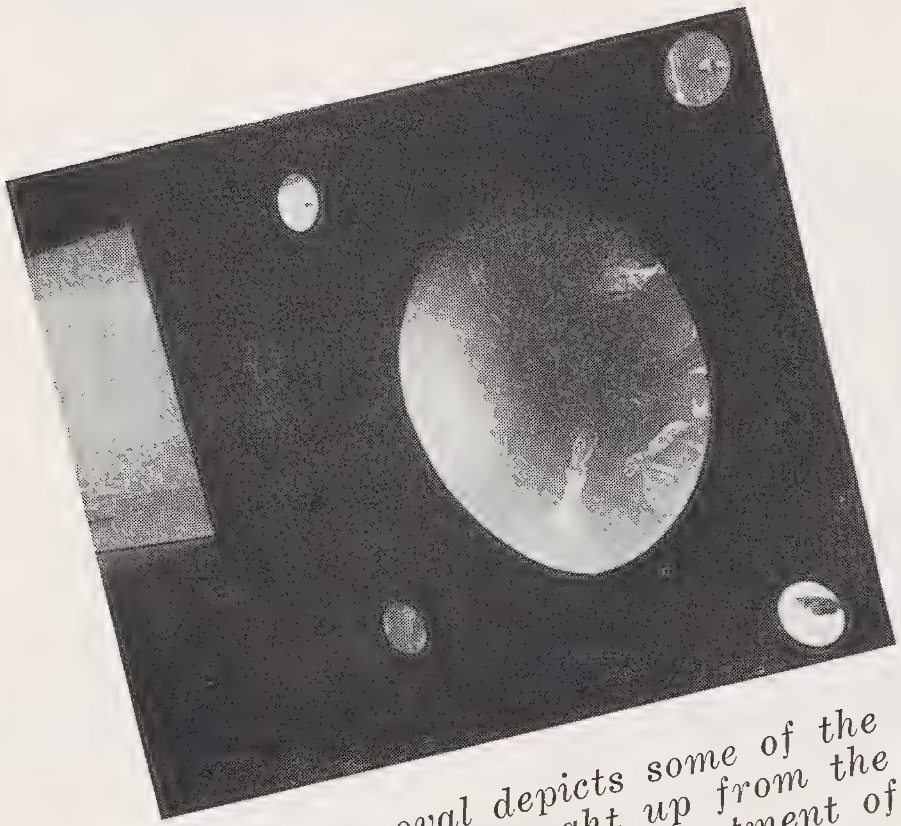




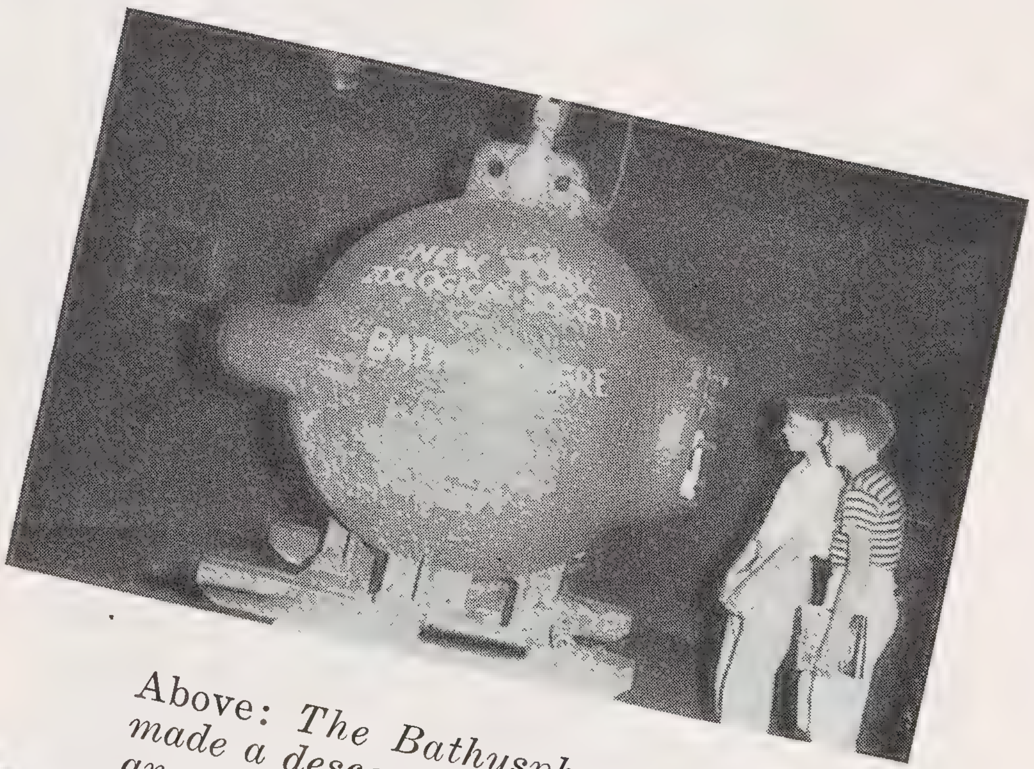
Above: *A diorama representing the Hudson Gorge as it was a million years ago.*



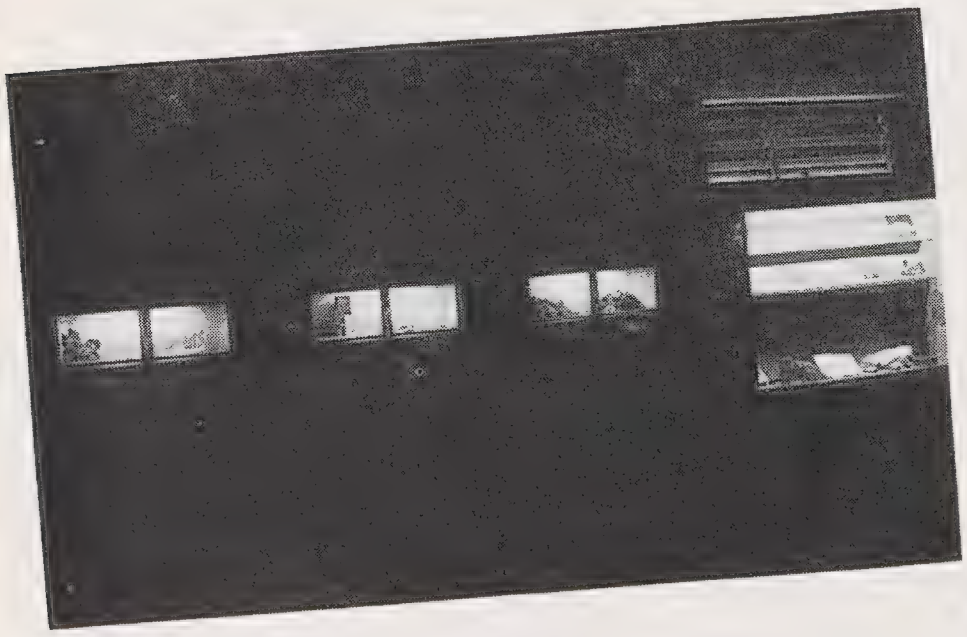
Above: *Another diorama, showing the Hudson Gorge as it appears today—a geologic change of vast proportions having taken place here.*

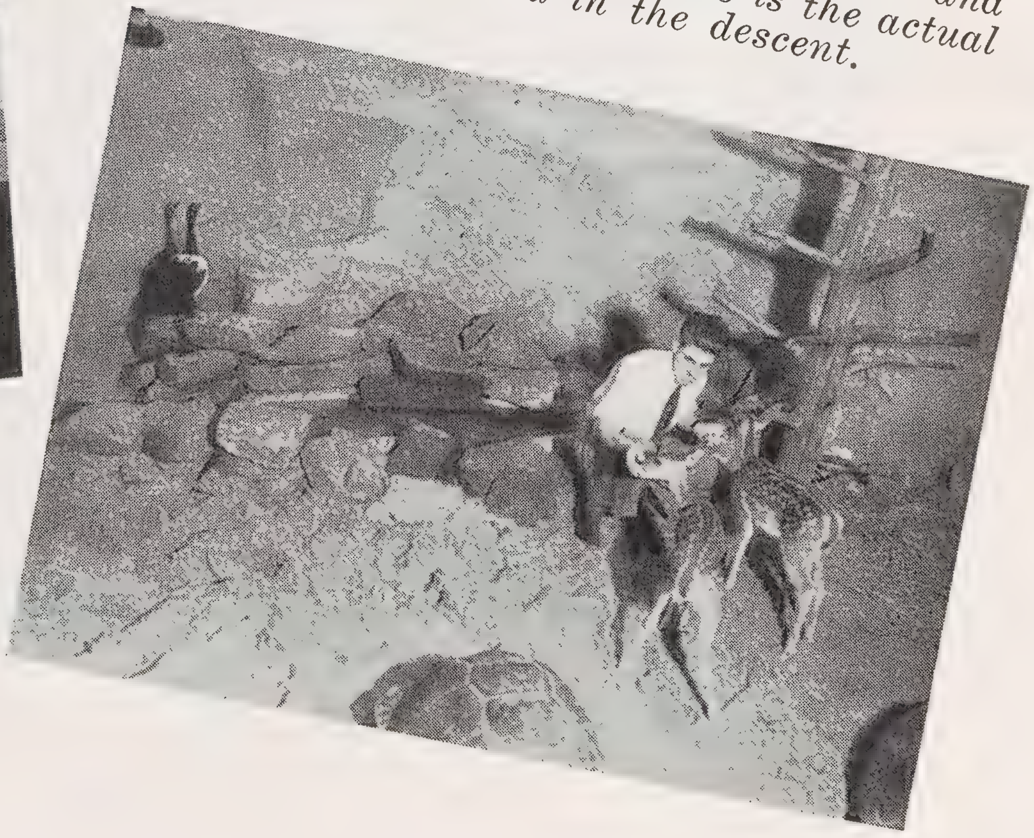


Above: *The large oval depicts some of the curious types of fish brought up from the depths of the ocean by the Department of Tropical Research on its expeditions.*



Above: *The Bathysphere in which Dr. Beebe made a descent of half a mile into the ocean is an exhibit that interests every visitor—and especially imaginative boys. This is the actual Bathysphere used in the descent.*





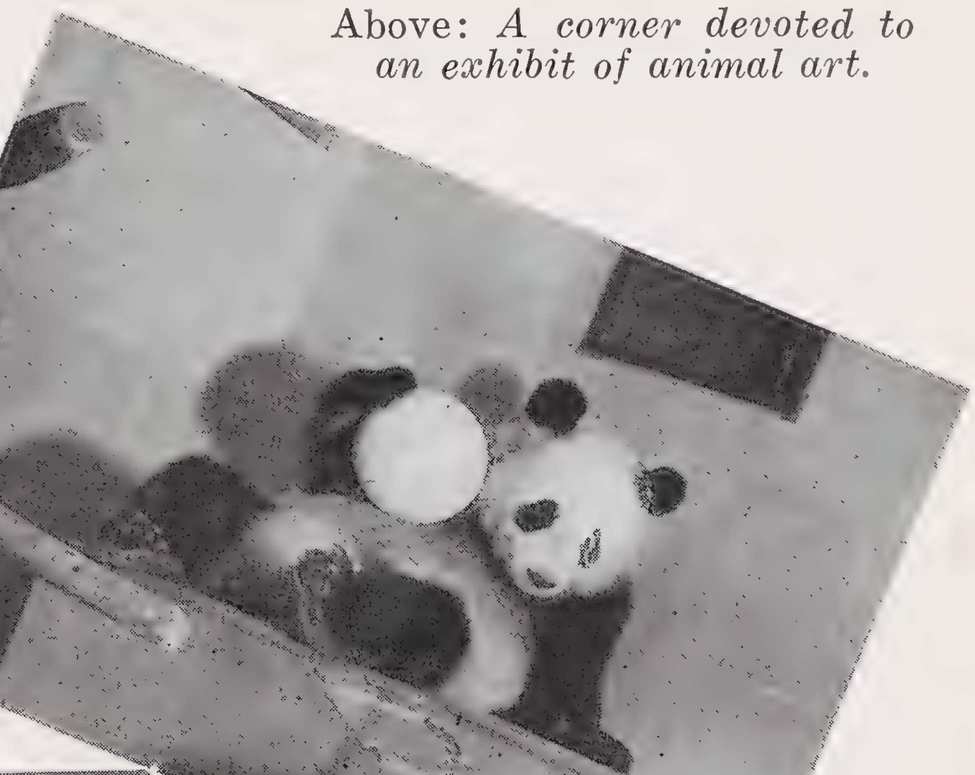
Above: *Part of the insect collection and a case containing the Bathysphere's instruments and log.* Right: *Feeding time for the fawns in the natural habitat group containing birds, mammals and giant tortoises.*

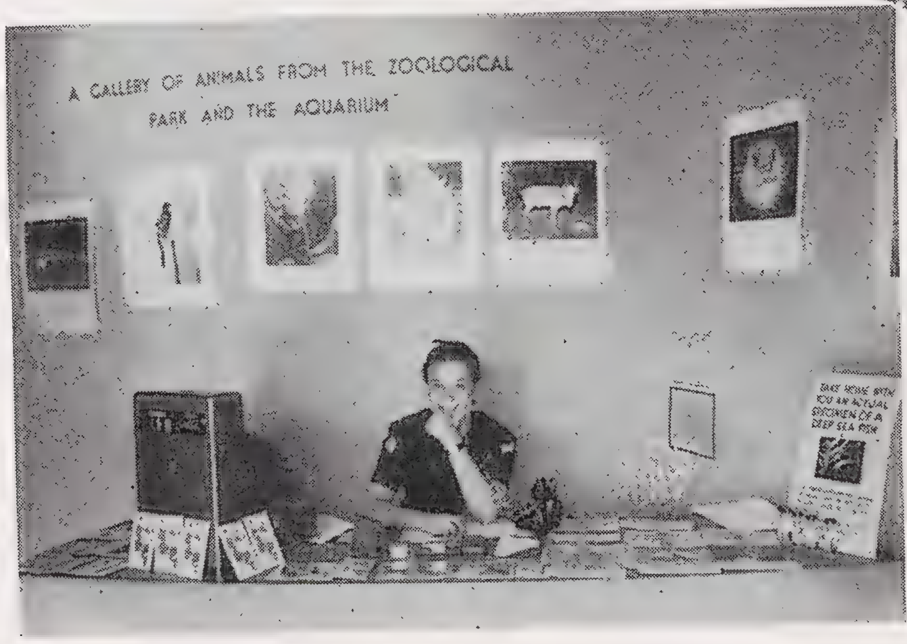
Above: *Amateur electricians gather around when the electrical powers of the eel are demonstrated. The eel operates the apparatus seen in the background.* Upper Right: *An illuminated panel explaining some of the properties of colors as seen in feathers—an explanation that astonishes almost everyone.*

Above: *A corner devoted to an exhibit of animal art.*

The GIANT PANDA
PANDORA WAS CALLED THE FLYING BABY PANDA WHEN SHE CAME TO THE NEW YORK ZOOLOGICAL PARK IN 1938. SHE FLEW FROM THE INTERIOR OF CHINA TO THE COAST, CROSSED THE PACIFIC BY STEAMER AND FLEW ACROSS THE UNITED STATES. SHE WEIGHED 35 POUNDS WHEN SHE ARRIVED AND WILL WEIGH 200 OR MORE WHEN ADULT. LOVES ALMOST ALL VEGETABLES AND 25 SEPARATE ITEMS RANGING FROM BAKED POTATO TO IRON SALT ARE ON HER

Above: *When Pandora, the giant panda, begins her evening routine of play, the crowd abandons all the other exhibits and gathers around to laugh whole-heartedly at her rapid succession of antics.*




A GALLERY OF ANIMALS FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

Above: *Pandora—resting quietly for the moment to think of something to do next.* Left: *In the lobby of the building the information desk attendant displays souvenirs and publications of the Society.*

The Tiniest of Tarpon Now at the Aquarium

Forty-six Specimens Caught in Florida Range Down to Only a Little More Than Two Inches in Length—Found in a Newly-formed Pool

C. M. Breder, Jr.

EXTREMELY small tarpon are virtually unknown. As recently as 1927 Dr. Beebe wrote an engaging article[1] in this publication on his discovery of very small tarpon from the island of Haiti. His smallest specimen was three inches long. One specimen two and a quarter inches long was found years ago by Evermann and Marsh in Porto Rico. This is apparently still the smallest specimen on record except for the single larval specimen recently mentioned on these pages[2] in connection with the Aquarium's researches on this fish on the Florida west coast, and various unverified statements of many years ago that are now past all possibility of checking. While the article on our tarpon research was being prepared for printing, Mr. Bishop had again returned to Florida to continue his operations, mostly concerned with the tagging of large fish.

As he would come across specimens of exhibition value of one kind or another, it was his custom to ship them north for the Aquarium's display of marine species. To our great amazement, three cans were opened on August 12 that contained the tiniest of tarpon. Two died as a result of transportation difficulties. One measured 2¾ inches and the other 2⅜ inches over all. The others, all living, to the number of 46, are somewhat larger and some even slightly smaller. In other words, living here at the Aquarium on public exhibition are some of the tiniest tarpon ever to be seen by man.

In addition to their intrinsic interest, due to their small size, is the fact that we wanted to have tarpon "coming along" some day to replace the fine, large fish that have been growing and thriving so well for the last three years. Eventually they must go the way of all flesh—how soon no one can even guess, since these are the first to ever be kept for any length of time in an aquarium. Certainly at the present their demise would seem far from imminent. Now that we know more about the hardihood and habits of this sporting fish as a "domestic animal," we will be able to keep better growth records on this second school than we dared try on the first.

This collection of fish, then, represents a double value—that of their exhibition interest, which is naturally considerable, and that of comprising one facet in our study of the life history of this striking fish.

Mr. Bishop, who has been of such great value to the tarpon studies, is a most enthusiastic "tagger" of tarpon and it must be admitted that probably he would not have shipped north such a collection, and quite properly, if they had not been altogether too tiny to carry a tag. The tags used actually would cover an area about equal to that of the head of most of these specimens.

It has long been suspected that small tarpon may get into the odd places in which they are sometimes found by being driven in on the wings of a hurricane or late summer storm. Mr. Bishop was exceptionally fortunate in being in the field when two earlier-than-usual blows piled up the water into arms and other places that seldom are invaded by high water. Wherever there was such a connection with the sea Mr. Bishop plied his nets to see if the new ocean water brought anything in with it. Since he well knew from last season's work just what was in these places, he was in an excellent position to obtain a proper understanding of what was going on—if anything. Last year there were no such early storms and the places were either completely dry, or stagnant to such an extent that the only local species capable of survival was the air-breathing tarpon.

Place after place was visited and nothing but

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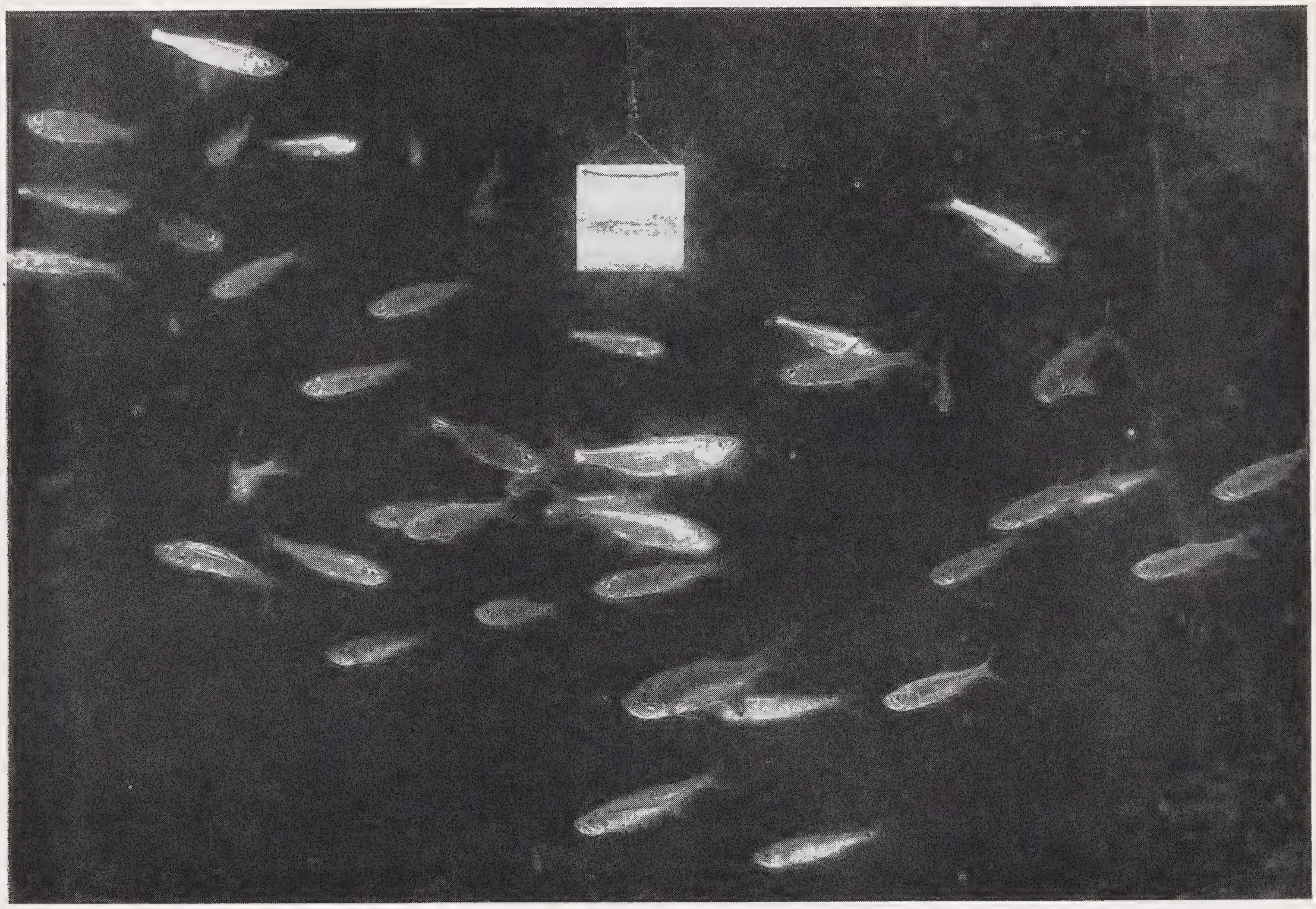
[1] *Bull. N. Y. Zool. Soc. 30* (5) :141-145.
[2] *Bull. N. Y. Zool. Soc. 42* (4) :98-110.



These are the smallest tarpon ever kept in captivity—part of a shipment of tarpon sent to the Aquarium from its research station in Florida. The white card hung in the tank, for the purposes of this photograph, is 2 inches square and gives a guide to the size of the fish.

the usual run of small shore fishes could be found in these freshly inundated pools. Mr. Bishop was about to give up and almost ready to invoke the old and feeble dodge of attributing the presences of fishes in odd places to wading birds carrying eggs adherent to their feet—only tarpon eggs are not sticky—when he came upon the last accessible place he knew about. This is on the south shore of Sanibel Island, near Point Ybel. Here, on overflowed land destined to become dry again shortly, he found his quest—tiny tarpon just as they entered these sequestered lagoons. The first time he saw this place it was still connected with the sea, but later was cut off and rapidly evaporating. These particular little tarpon were doomed to desiccation —or, as Bishop puts it, before that, to be cleaned up by the abundant bird life when the water subsides to a few inches, and before real desiccation commences. This would then appear to be the frequent fate of many little tarpon every time they attempt to venture inland. Only in this case some of them had the surprising experience of suddenly taking a trip to New York where certainly a much longer life awaits them.

The present interpretation of this would seem to be that these young tarpon may be fairly massed off shore in restricted locations—finding their way in certain inlets when high water comes—but not in inlets generally. This probably varies from year to year, which would account for their spotty occurrence in land-locked pools and Bishop's observations of this and last year.

The sizes of these fishes run down to a little more than two inches in total length. If the tarpon was an ordinary fish, one would be fully justified in referring them to the 1939 May-June spawning season. However, since tarpon are supposed to pass through a peculiar developmental stage called a leptocephalus, which should surely take a year or more, we cannot be too dogmatic about the age of these specimens. The search for intermediates to fill in the missing fragment in the life history picture thus still goes on.

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All pictures not otherwise credited are from the photographic collection of the New York Zoological Park and the Aquarium.

Notes from the Zoological Park and the Aquarium

Dr. Leonard J. Goss

Dr. Leonard J. Goss, former pathologist for the Department of Animal Pathology of the Kentucky Agriculture Experiment Station, has joined the staff of the New York Zoological Park, succeeding Dr. Charles R. Schroeder who on August 1 returned to the Department of Pathology of the San Diego Zoo.

Dr. Goss was born in Manhattan, Kansas, and received the degree of D.V.M. from Ohio State University Veterinary College. Subsequently he was instructor in veterinary pathology at New York State Veterinary College, receiving the degree of Ph. D. from Cornell University. His work in the Kentucky Agriculture Experiment Station immediately preceded his acceptance of the post in the New York Zoological Park.

As the fourth veterinarian in the Zoological Park's history—Dr. W. Reid Blair, Dr. Charles V. Noback and Dr. Schroeder preceding him—Dr. Goss brings to his work a valuable practical experience and is ably equipped to take care of the health of the collection and to carry on research.

Young Muskoxen

Late in September the Zoological Park received four young muskoxen, brought back from the north by Captain "Bob" Bartlett, through whose efforts we have received many specimens in the past. The regulations of the Bureau of Animal Industry required that the young animals be kept in quarantine for a sufficient period to reveal latent disease, and this is being carried out in an isolated building in the Park. Early in October the animals will be placed on exhibition. All four appear to be extremely healthy and active.

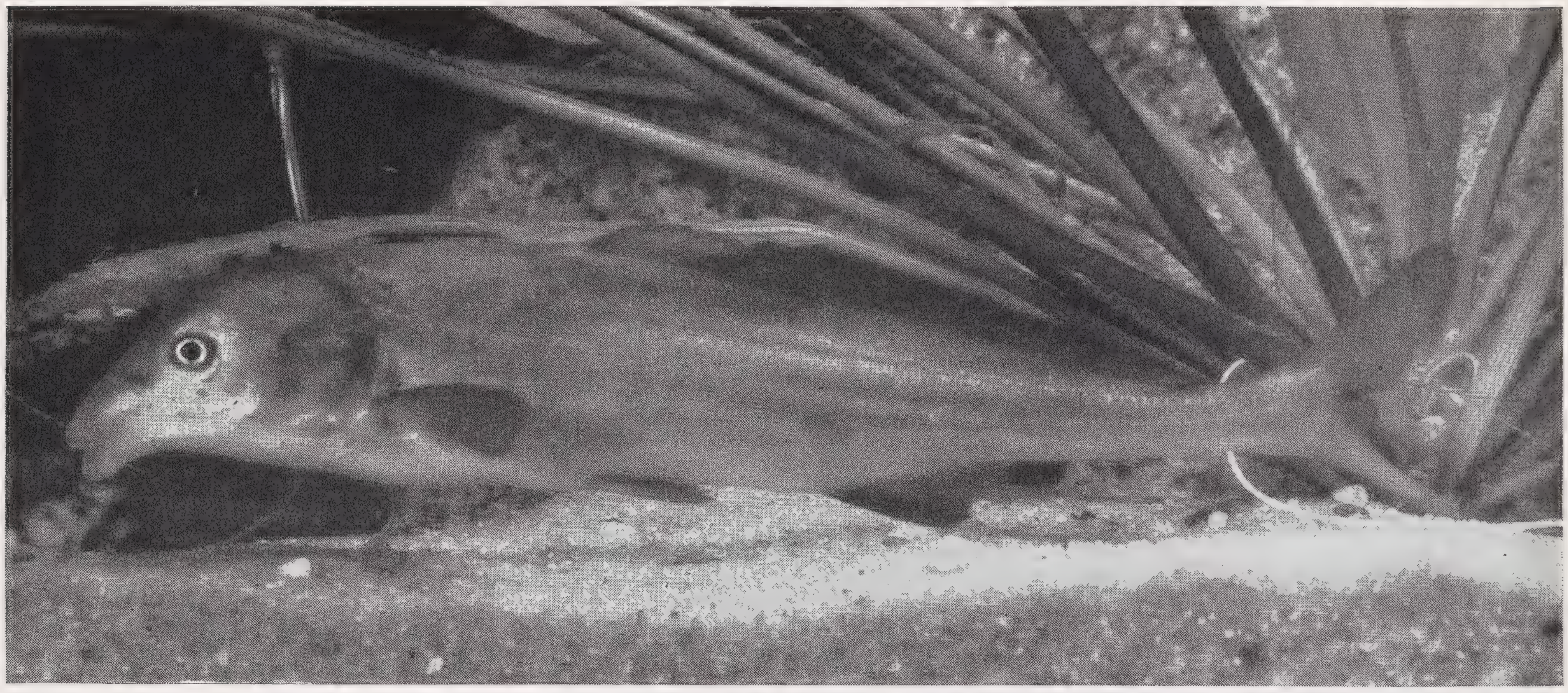
Visitors on Lake Agassiz

There is an intangible something about the wading birds that is especially fascinating to many bird-lovers—myself included. It isn't so much their graceful flight and plaintive notes, for many birds can duplicate them. It seems to be more closely connected with the weirdness of their chosen haunts—the shallow waters of inaccessible swamps, treacherous mud flats exposed at low tide or the limitless sandy beaches of the sea. Unless one is willing to undergo some privation, waders are likely to remain on the unseen list.

That is why a recent spectacle in the Zoological Park was an unexpected and unusual treat. Lake Agassiz, our largest body of water, has always been the recipient of great quantities of silt, which is deposited, along with various other items, by flood waters. As one of its projects, the WPA is now undertaking the removal of this choking mass, which mars the beauty of our lake. On August 4, the outlet valve in the old dam that stems the waters of the Bronx River was opened and the level of the lake soon commenced to drop. There is a space along the balustrade on the eastern side of the roadway leading from the Concourse Gate that gives an excellent view of the lake and here our visitors are wont to gather and enjoy what is ordinarily a really lovely vista. On the morning following the opening of the valve, early comers were somewhat disappointed to find that small mud flats were already appearing where placid waters should have been. Closer inspection, however, gave promise of compensation. Just under the wall, at the edge of the lake, a slender grayish form revealed itself as a Solitary Sandpiper, busily and hopefully exploring the exposed mud for whatever good it might hold. Farther out, a group of two or three Lesser Yellowlegs stalked, with as much dignity as a small bird can command.

But this was only the beginning. Each day brought birds in increasing numbers. Expert field naturalists began to gather, arguing over identities. Beginners, with glasses glued to eyes, slowly picked out the characters of species previously unseen. It was a whole series of field days for everyone, including the general public. Lesser Yellowlegs actually gathered in hundreds, with a scattering of Solitary Sandpipers, Spotted Sandpipers and Killdeer Plovers. There were hordes of "Peeps," never truly identified but which probably included Least and Semipalmated Sandpipers. There was also an American Coot, a solemn and lumbering bird which aroused a great deal of interest, but later turned out to be a sort of hoax.

After a week of excitement, the slowly lowering waters left the attractive mud banks so far behind that they began to dry out and our fascinating visitors left as quickly as they had come. And then we found out about the Coot. A rather shamefaced keeper reported that a Coot had escaped from the Flying Cage and he had refrained from reporting it because he felt he might get it back. And this morning it had returned, walking in circles around the great cage, hoping to find an entrance. The keeper had opened a door guardedly, the bird had walked in with gratitude and the episode could be reported as closed.—L. S. C.



One of the strange fishes of the Nile—a mormyrid of the second species to reach the United States alive. This mormyrid, with peculiarly rounded head and smooth, downwardly-directed snout, is Mormyrus kannume. *In some others the snout is much longer.*

A Second Mormyrid Reaches America

A recent issue of the *Bulletin*[1] carried a story of the strange fishes of the Nile that are linked with the mythology of the early Egyptians, on the occasion of one of these fishes reaching American shores for the first time. Many and varied are the forms that these creatures take, but the one we first received (*Marcusenius kingslayae*) was not particularly impressive. In fact, it was a little fish of very ordinary appearance. Consequently, we were greatly pleased to receive specimens of another species. This kind of mormyrid, *Mormyrus kannume* Forskål, is a big improvement over the first, although it still leaves much to be desired when compared with those bizarre species in which the snout is so elongated downward as to appear to be a pendant elephantine trunk.

These new fish are exceedingly fast and active and are inclined to be quarrelsome. Their quarrelsomeness reached such a point that it was essential to separate each from the others. There are four individuals of this newest arrival and until some means can be found for keeping them together in peace, there can be little hope of studying much more than their locomotor and feeding habits. As in the earlier species, their respiration rate is fast, although they do not seem to be of quite such a nervous temperament. The accompanying photograph was not too easy to get for it was taken as the fish "whizzed" past at a fast clip. Although it was moving at much less than top speed, Mr. Dunton tells me that he nevertheless found it necessary to use an exposure of 1/150 of a second in order to stop motion.

These specimens came from the upper Nile and were imported into this country by Paramount Aquarium, Inc., by way of Hamburg. The species, known from the Lower Nile to Lake Victoria, reaches a length of not quite two feet. The present specimens are somewhat less than half that. Both species are of a soft leaden gray coloration, nearly uniform throughout except for a general lightening below. Mr. Coates, who has been active in arranging for the importation of members of this family of unusual fishes, is to be congratulated on obtaining these two species.

Presumably this form has the typically huge brain characteristic of the family. We are still uncertain of the exact function of the excess tissue. In any case, it would appear that these fishes are not as sensitive to handling as we had been led to believe. Those discussed previously are still thriving, although to date they have shown no evidence of any breeding activity, something which was hoped for and is still anticipated. —C. M. B., Jr.

Baby Loggerheads from the Fair

The Florida State Building at the World's Fair was temporarily turned into a nursery when a batch of about 96 loggerhead turtle eggs hatched out during the middle of August. The eggs, together with the sand surrounding them, had been sent to the Fair by R. H. Poole, Jr., of the Marine Studios at St. Augustine. Unable to care for so many babies, the Florida exhibit donated most of them to the Aquarium on August 20.

The little fellows have upper shells only 1.8 inches long and 1.5 inches wide and weigh about .6 of an ounce. They have all the popular appeal that mammalian babies generally exhibit, what with their diminutive size and slightly awkward actions.

Loggerhead turtles are found throughout the tropical and sub-tropical Atlantic Ocean and in the Mediterranean Sea. They undoubtedly never come ashore voluntarily except to lay their eggs, which are deposited in sandy beaches above the tide line. They sometimes attain a weight of 450 pounds, more than 11,000 times the weight of a hatchling.—J. W. A.

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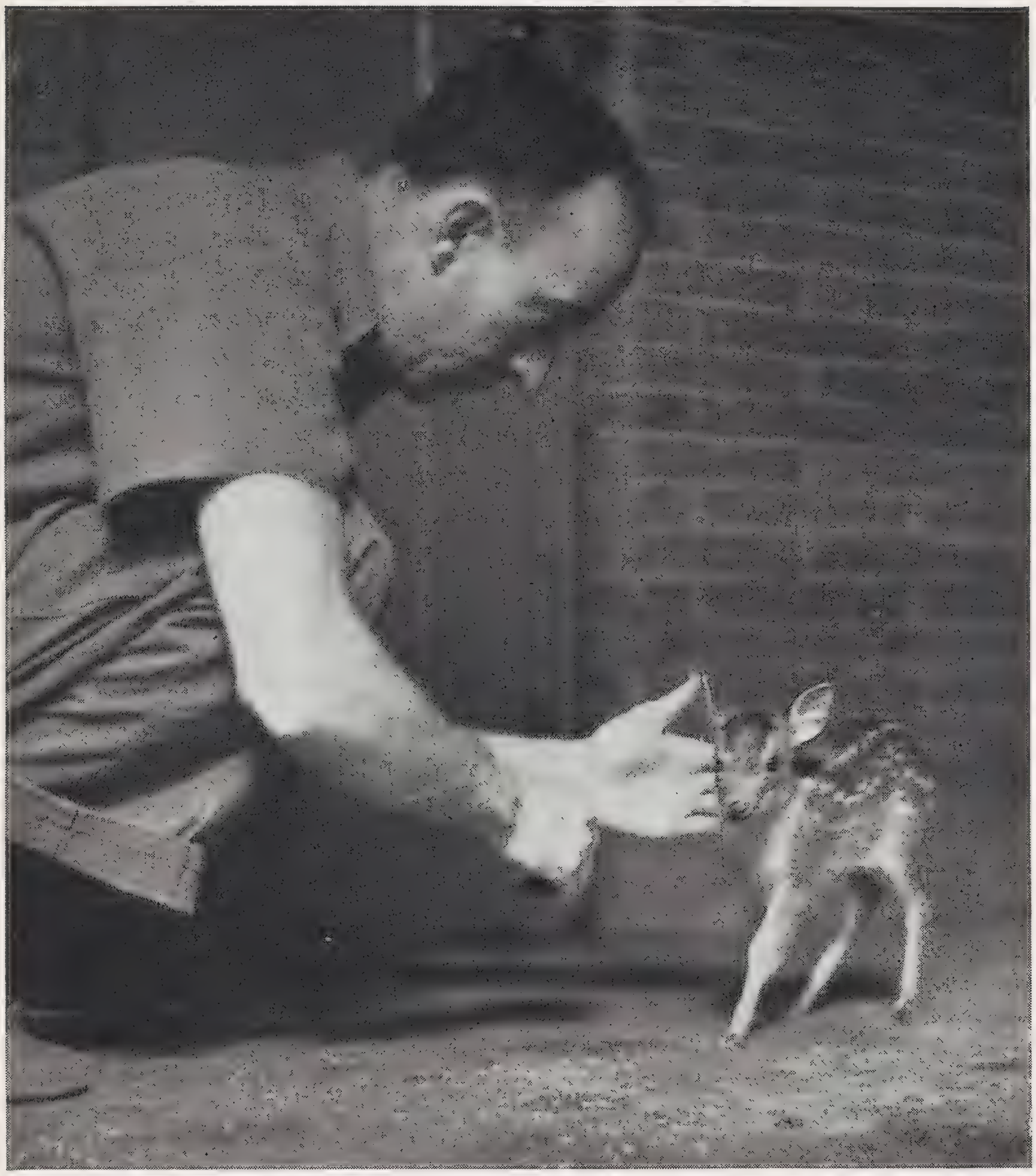
[1] *Bull. N.Y.Z.S.* 42 (1) :15-18.



"Crisis," the baby Reeves muntjac, is a tiny creature scarcely larger than the hand of its keeper.

"Crisis" in the Zoo!

Apart from an occasional grunt or the click of hooves, silence generally reigns among the inmates of the Kangaroo and Wild Swine House. And so it was all the more startling when, on the morning of Wednesday, August 30, a thin, shrill, wavering cry interrupted the keeper at his tasks. It came from the direction of the Reeves muntjac cage and the keeper hurried to investigate.

A fawn had been born—certainly one of the handsomest and most delicate babies ever born in the Zoological Park. Its fragile legs would not yet support its pound-and-a-half, white-spotted body, but its voice was in perfect working order and it was crying for its first feeding.

Its cry, like that of the adults, is seldom heard, but one that is not easily forgotten. Few visitors will have a chance to hear the peculiar voice of the muntjac, for ordinarily it is silent except in early morning or late afternoon.

The mother has proved to be gentle and affectionate and the baby is thriving. The parents are two of the three animals—two males and a female—received on August 2, 1938. Muntjacs, also known as rib-faced deer, come from India and southeastern China, *Muntiacus reevesi* being found in the latter area.

Because the baby was born on the day that saw the tension in Europe coming to a head, Dr. Blair aptly named it "Crisis."—W. T. CULLY

The female Reeves muntjac was full of solicitude for her offspring and apparently is going to be a good mother to little "Crisis."

Praise for Pandora

Zoologists, in their enthusiasm for an animal that arouses their professional interest and curiosity, often prize it more highly than the general public. Not so, however, with the giant panda; scientific interest in the animal could hardly be greater than that of visitors to the Zoological Society's building at the World's Fair, where "Pandora" is on exhibition.

On August 9 the New York *Sun* commented editorially:

> Protecting the Panda
>
> At a recent meeting in London of the Society for the Preservation of the Fauna of the Empire it was reported that the Provincial Government of Szechuen had issued an order forbidding the capture of giant pandas and that the Burmese government had issued an order prohibiting the export of pandas from British Burma. These orders, the result of representations by the society, are believed to provide effective protection for one of the world's most appealing animals. Visitors to the New York World's Fair have reason to be grateful that these protective measures were put in effect this year rather than earlier; otherwise Pandora, the giant panda to be seen at the Zoological Society's exhibit at the Fair, might be missing. Pandora is properly housed in the amusement area, for her unpremeditated and inconsecutive antics are among the prime amusements at the Fair. Those who have not seen this animal should be advised that she is at her liveliest late in the evening; that her repertory is unlimited and unpredictable; and that there is something about the virtuosity of the whole performance that kindles the suspicion that Pandora knows that she is comical and cherishes the knowledge. A beast so rare, so remote from ordinary experience, so gifted as a comic, is doubly pleasing because, unlike the comedian monkeys, there is no implied caricature of man.

Gifts of Hummingbirds

For several months the bird collection has lacked specimens of the common ruby-throated hummingbird and when the fall migration season arrived without the usual telephone messages announcing the discovery of exhausted birds in the city streets, Curator Crandall became reconciled to the likelihood of doing without them in the new hummingbird cage.

Then, within a week's time, three hummers arrived. The first came on September 13 from A. J. Scalay of the Boy Scout Foundation of 120 West 42nd street. The bird, in fair condition except for exhaustion and lack of food, had dropped onto a pedestrian's hat in West 32nd street.

On September 18 James J. Sheehan, manager of a grocery store at Woodycrest avenue and 165th street, phoned that he found a hummingbird lying among a heap of oranges in a box in front of his store.

That bird, too, was quickly revived in the Bird House quarantine room, and the following day E. Hudson sent the department a ruby-throat which had been found exhausted on the sidewalk at 104 East 25th street.

When the birds gain sufficient strength and are on a regular feeding schedule, they will be introduced, one at a time, in the hummingbird cage which now contains five Caribbean emerald hummers. The present occupants have well-defined territories staked out in the cage, where no trespassers are permitted, and if the newcomers can find a place for themselves they should make an excellent exhibit this winter.

War Troubles Already

Less than a month after the beginning of the European war, the Aquarium has begun to encounter difficulty in getting specimens for its collections. The pinch has not reached serious proportions yet, but replacements of many groups of fishes have already stopped coming and no substitute sources have been developed.

For many years it has been the practice of the larger fish importing houses to tranship specimens at Hamburg—particularly fishes from Africa, the Mediterranean, the Indian ocean, the East Indies and Asiatic fishes generally. All such supplies were cut off instantly when England and France declared war.

Exchanges of specimens with the London Aquarium are at a standstill, naturally; one transatlantic liner that arrived here two days after the declaration of hostilities brought a cargo of sea soldiers, locust lobsters, scorpion fish, pink wrasse and giant whelks—the last such exchanges that are likely to be made for some time. The professional fish attendant who had long supervised the shipments of fish between the New York and London Aquariums found transfer orders awaiting him when the liner docked in New York, and went to sea again on another vessel even before he could turn the cargo over to the Aquarium here.

Similar sudden changes in personnel have taken place on many of the vessels that have been accustomed to carrying fishes, and the Aquarium at the present time has lost all track of at least ten fish "runners," or attendants, who have been carrying fish for them for years.

Fish dealers are now making plans to continue the importation of East Indian and Asiatic fish through Pacific Ocean channels. However, it takes a great deal of time and money to institute such a service—about $20,000 is required to equip each vessel to carry fish. In addition, a new personnel will have to be trained to handle the fish en route.

Some few fishes continue to come in from South America and until trans-Pacific connections are made, American aquariums will probably have to depend upon the South American waters to supply the bulk of their replacements. Only one boat has brought a sizeable cargo of fishes from South America since the beginning of the war and all shipping movements have been shrouded in so much mystery since the outbreak of the war that the time of arrival of other vessels is highly uncertain.

The New York Aquarium will attempt, if Asiatic fishes do eventually reach San Francisco, to transport them across the continent by rail.

Eagle Story

It all started several years ago when Keeper Atkin of the Bird Department went into the golden eagle aviary one morning to wash the walls.

Hosing down the aviary was a routine task that Atkin had performed for years, with no hint of trouble from the big eagle. Usually it flapped up to the high perch, several feet above the keeper's head, and paid no further attention to him.

Then came the morning when Atkin, bending over to scour a drinking pan and momentarily off balance, was knocked flat on the floor of the cage by the hurtling body of the eagle. It all happened in a flash; apparently the eagle dropped straight down from the perch onto Atkin's back, toppled him over—and before he knew what was happening the keeper found himself sprawled on the ground with the eagle astride his legs, one set of talons digging into his right leg just above the knee and the other gripping his left knee.

Fortunately for Atkin, the heavy hose had fallen across his body and the eagle's talons gripped the rubber as well as flesh. Otherwise the sharp nails would certainly have dug deeply into Atkin's legs. It was bad enough as it was; the keeper made one tentative wriggle to throw the bird off and tightening of its grip punctured his skin.

There was nothing to do but wait—and hope that a fellow keeper would pass by and come to his rescue. It was early in the morning and no visitors were around to give the alarm. Atkin waited, and so did the eagle, and the bird was the first to weary of the profitless business. After a time that seemed an eternity to Atkins, but was probably about two minutes, the eagle relaxed its grip, crouched, and flapped up to his perch again. Atkin scrambled for the door.

So much for what happened.

More than a year ago Curator Crandall was asked by a magazine to write a brief article commenting on the familiar belief that eagles can—and do—carry off human babies. In the course of his refutation of the myth, he recounted the adventure that had happened to Keeper Atkin.

Nothing more was heard of the story, after its publication, until a few weeks ago when Richard H. Pough of the National Association of Audubon Societies forwarded a clipping from a Swiss newspaper, the *Basler Nachrichten*, with a query: "What on earth is the truth of this yarn?"

The *Basler Nachrichten's* article was entitled: "An Eagle Lifts a Man Up," and in circumstantial detail it gave a report "by a scholar, who is charged with the oversight of the bird collection in the great New York Zoological Garden, which shows what astonishing strength an eagle possesses." According to the Swiss newspaper's correspondent, Keeper Atkin was going about his morning's work when suddenly he found himself seized and carried to the top of the cage!

The story was, in almost every way, a faithful paraphrase of Mr. Crandall's published version . . . except that instead of the eagle knocking the keeper to the floor, it carried him up to the ceiling!

Mr. Crandall of course hastened to give Mr. Pough an account of the actual facts, and the latter in turn transmitted them to the *Basler Nachrichten*. Now a copy of the issue of July 21 has been received in which the true version of the attack is set forth at length and the inversion in the original story is blamed on "an error in translating from the English, which turned a comparatively simple incident into a sensation, at the expense of the reputation of our eagles."

PUBLICATIONS OF INTEREST

TURTLES OF THE UNITED STATES AND CANADA. By Clifford H. Pope. 343 pages. 99 photographic illustrations. Alfred A. Knopf, New York. $3.75.

There has long been need for a good book on American turtles, both a readable book and something with detailed, formal listing. Mr. Pope's new publication is a fine combination of both. The author is a skilled systematic worker with reptiles and in contact with all sources in which new observations and scientific deductions are published. His book shows thorough research of the literature in bringing together about everything that is known about North American turtles. Also, the original set of photographs is prepared to bring out details of turtle structure and markings. The majority of the illustrations were taken especially for this book by Mark Mooney, Jr., of the Philadelphia Zoological Garden.

The North American turtles vary greatly in size and structure. The book enumerates a total of sixty-two kinds, ranging in size from the cumbersome sea turtles, whose weights are figured in hundreds of pounds, down through the big fresh-water snapping turtles, the terrapins and a variety of lesser forms to the musk and mud turtles, which are among the smallest kinds. The treatment of scientific names shows meticulous care in bringing formal listing strictly up to date. This has been a difficult job and indicates that it took months of deduction. The treatment of the genus *Pseudemys* is an example. It took real courage to dig into that difficult genus and set it in order. I remember once speaking to a prominent American herpetologist about doing this same thing. He remarked: "Well, there is ground where angels fear to tread." Mr. Pope's deductions are at considerable variance with the recently published check list of North American Amphibians and Reptiles, by Stejneger and Barbour. But, of course scientists have the right to express respective opinions, and there is anything but general agreement among them.

The book leads off with some readable chapters about general structure and habits. The courtship of turtles is treated with such elaboration that it would seem there is nothing more to be discovered. Going into the main part of the book the reader comes to the descriptions of species. These are presented with enough details and in formal enough manner to satisfy the scientific student. There are tables of measurements, followed by highly detailed descriptions of habits, incorporating the author's observations and quoting the notes of many others. This gleaning of the literature, crediting of authors and references to their writings, produces a book of high value. Mr. Pope has done a particularly fine job and has filled a gap in herpetological literature.—R. L. D.

Serpents of the Northeastern States

By Raymond L. Ditmars

HERE is a comprehensive, yet compact, book about the snakes of the northeastern states that will prove to be extremely useful to everyone with a summer home or camp in that region. This guide to the venomous and non-venomous reptiles of the New England area, New York, New Jersey and eastern Pennsylvania, is a practical and handy reference work. It gives a key for ready identification of snakes, descriptions of their feeding and breeding habits, notes on distribution and photographs of every species found in the northeastern states, including color plates of the copperhead and rattlesnake. One section is devoted to the emergency treatment of snakebite.

"Serpents of the Northeastern States" was originally published as a complete number of the BULLETIN and several reprintings were quickly exhausted. It has been republished in a new format, somewhat revised as to text and nomenclature, and four photographs have been added.

60 pages, 41 illustrations. *50 cents postpaid.*

Department of Publication & Photography
NEW YORK ZOOLOGICAL PARK
185th Street & Southern Boulevard
New York, N. Y.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Forty-one volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XXIII are complete and indexed. Volume XXIV will be issued during 1939, in quarterly parts. *Zoologica* is sent to members on request.

[*Zoopathologica,* Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica*. *Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica,* as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to Publication Office, Zoological Park, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

Clark and Fritts, New York, Printers.

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Ever since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is $10, renewable annually. Life Membership may be obtained for $200. A contributor of $1,000 becomes a Patron; $2,500 an Associate Founder; $5,000 a Founder; $10,000 a Founder in Perpetuity, and $25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.

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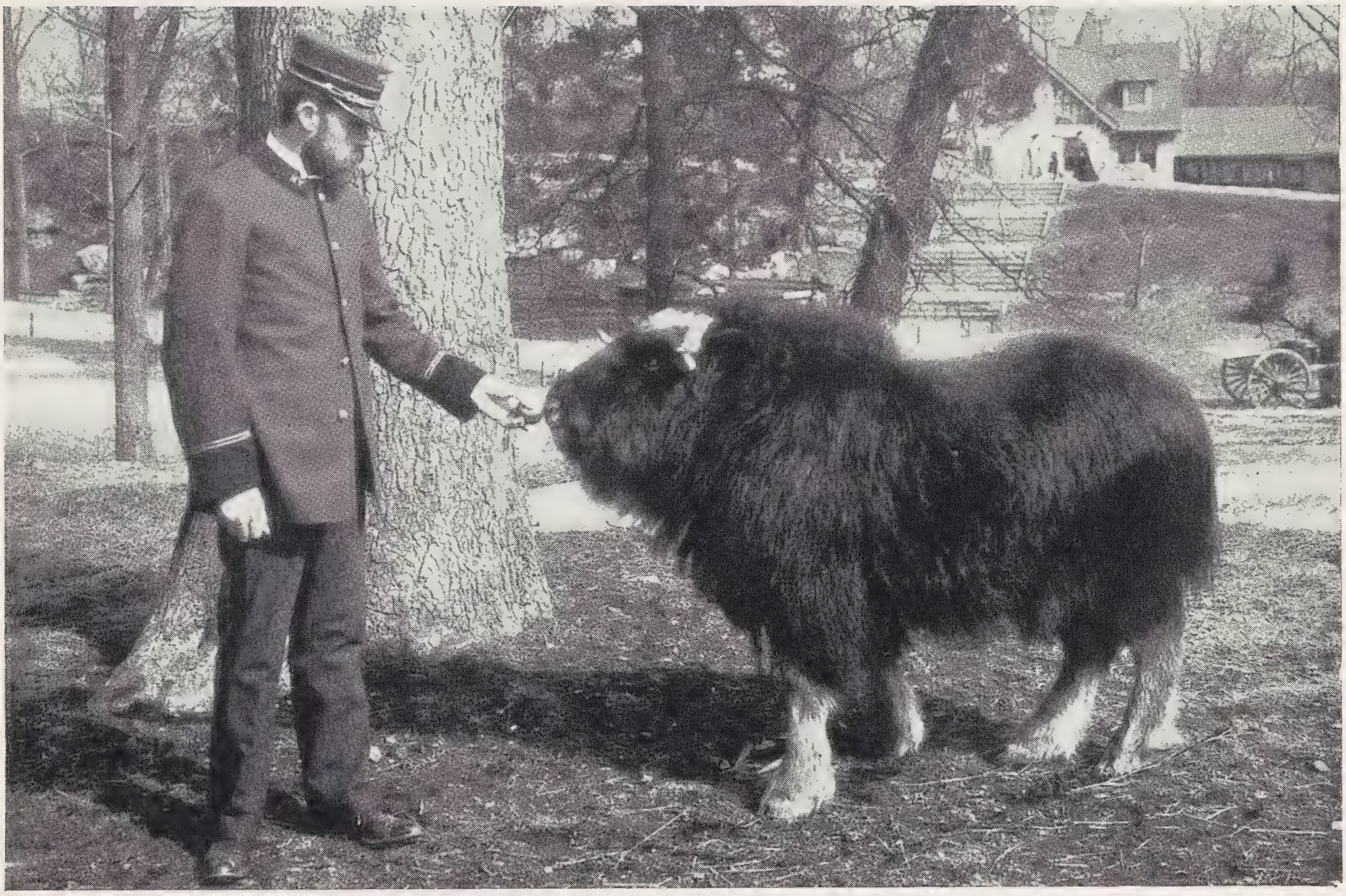

The first muskox exhibited in the United States—the famous $1,600 specimen from the Barren Grounds of Canada. This picture was taken in 1902, soon after the animal arrived. The building in the background is the Rocking Stone Restaurant.

BULLETIN
NEW YORK ZOOLOGICAL SOCIETY

Published by the New York Zoological Society

Vol. XLII November-December, 1939 No. 6

Four Stubborn Babies from Greenland

Captain Bob Bartlett Brings Us Two Pairs of Muskox Calves, the First Exhibited Here in Almost Ten Years

William Bridges

High up on the map of eastern Greenland where the lines of longitude shrink together in the Arctic cold, the broad promontory of Hudson Land commemorates the northern limit of Henry Hudson's coastal cruise in the *Hopeful* expedition of 1607. Muskox Fjord on the south and an equally deep cleft on the north trim it roughly into the shape of a hammerhead shark. Ice barriers protect it ten months of the year, but in the brief midsummer it is green and lush with knee-high grass and here the white-fronted muskoxen thrive in probably greater numbers than anywhere else in the northland.

Out of Hudson Land Captain "Bob" Bartlett brought four muskoxen to the Zoological Park on September 14, the first muskoxen we have exhibited in almost exactly ten years. And if Captain Bob's present frame of mind continues, they will be the last that he will bring.

"Work! I don't mind work. Brought up on it. But this was too much. Those little devils ate twenty cases of milk and I'd hate to say how much cereal and grass and willows. I stripped the east coast of Greenland of willows. No, *sir!*

But it was worth the work and the worry and the willows. The muskoxen, still babies, of last April's crop, arrived in apparently perfect health and condition. Among all the twenty-six muskoxen we have exhibited since the famous first specimen of 1902, these four stubborn babies are unsurpassed. Under the regulations of the Bureau of Animal Industry, not to be relaxed even for animals from the Arctic wastes, they had to be tested for tuberculosis and quarantined for thirty days. They were tested and they were quarantined, and their record is clear. Quarantine was permitted in the Zoological Park, and so from mid-September to mid-October the muskoxen were confined to a shelter along the southern tier of deer ranges. It was no hardship on them; handreared as these were aboard Captain Bartlett's *Effie M. Morrissey* and constantly petted by their caretaker aboard ship, they retain a full measure of the muskox's suspicion and defiance of the world. Their every action during and since quarantine announces that they want to be let alone. And, fortunately for their keeper and the Veterinarian, they *can* be let alone.

Out of the many summer cruises to the Arctic Circle that Captain Bartlett has made aboard the *Morrissey,* he has gained a definite impression that muskoxen are increasing along the east coast of Greenland. Without making any special effort to find muskoxen, apart from small herds with calves which he could capture, he believes he saw "about fifty altogether, bulls and cows and calves," and his collecting party penetrated Hudson Land only about eight miles, in one restricted locality.

The four calves in our collection were all captured between July 28 and August 14. A collecting party from the ship, consisting of six to eight men, was sent ashore while the *Morrissey*

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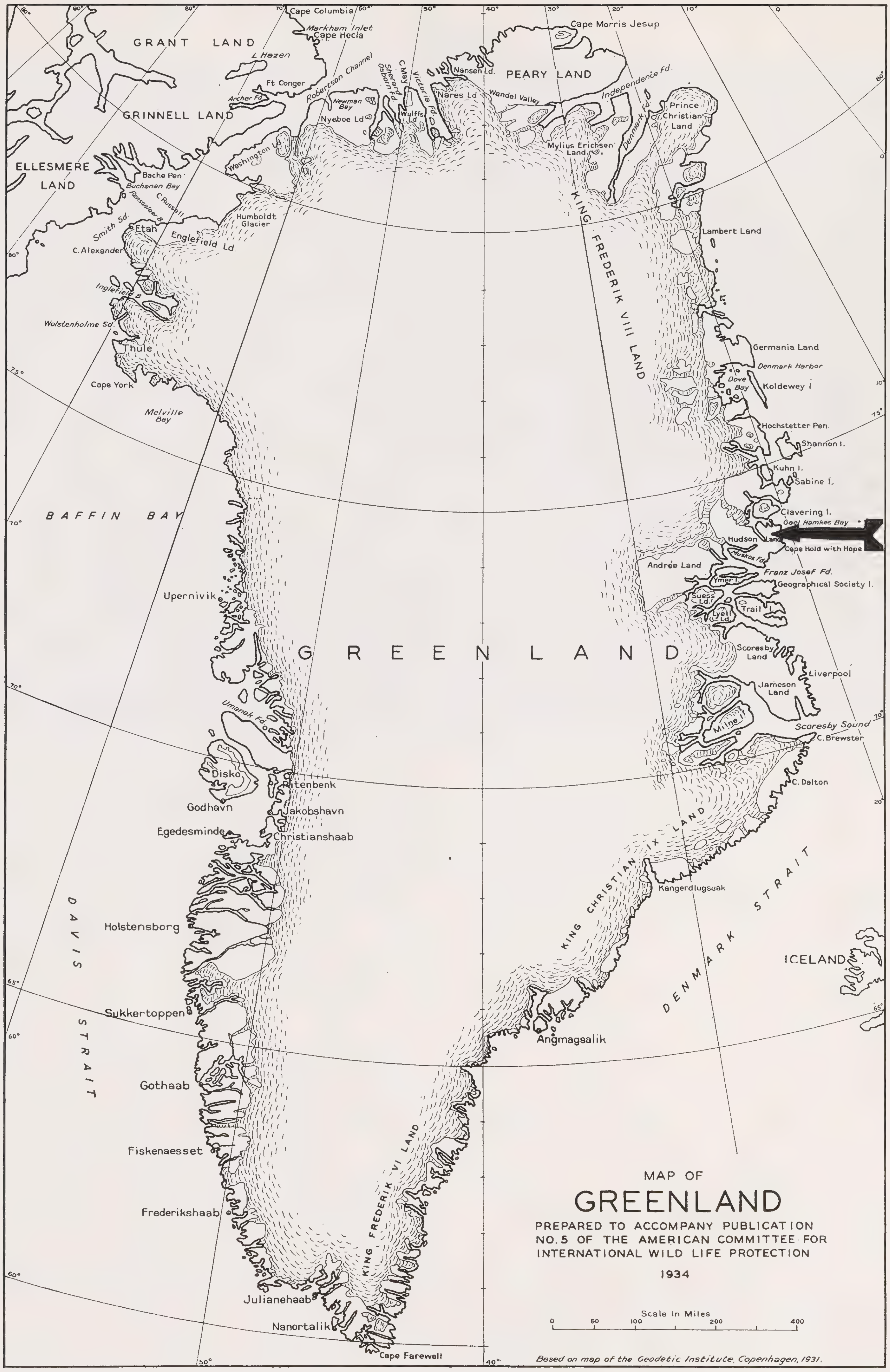


East and north Greenland are the domain of the white-fronted musk-oxen and they are probably more plentiful in Hudson Land than anywhere else. The arrow shows where our present specimens were caught.

Courtesy John K. Howard

To the human eye, the east coast of Greenland appears barren and forbidding even in summer, but it provides plenty of forage for the muskox. This picture was taken in August of 1933 *and shows a very large old bull muskox and two younger individuals.*

was anchored in Clavering Sound and made daily excursions inland until it found small herds that could be easily handled.

Previous to Paul J. Rainey's expedition in 1910, which resulted in six muskox calves being brought back to the Zoological Park, it appears to have been the almost invariable practice of collectors to capture calves by slaughtering the adults in the herd. A careful and intelligent collector would search until he found an isolated group of four or five muskoxen with one or two calves, and would thus make his own work easier, as well as conserving the lives of the animals. Many hunters were not so conscientious and there are records of large herds being butchered for the sake of one or two calves.

The Rainey expedition, however, developed a new technique of holding the adults at bay with dogs and lassoing the calves, so that no harm came to any of the animals. That method of course requires more skill and patience than the practice of killing the adults, and even after Rainey's day some collectors insisted that it could not be done. But in the Canadian Barren Grounds, as far back as 1898, Buffalo Jones thus roped and captured five yearling calves for the New York Zoological Park. True, he did not manage to deliver them, for on the way south from the Barren Grounds a party of Indians stole into camp at night and slaughtered the calves "to keep the other muskoxen from following them out of the country." But he showed that the roping of muskox calves was hardly more difficult than the roping of animals with which Jones was more familiar—the American bison.

Captain Bartlett's men employed the Rainey technique and with dogs and ropes captured the four little animals we are now exhibiting. At the time each one weighed only about fifty or sixty pounds; as soon as one had been cut out of the defensive circle of its elders, it was hoisted on the back of one of the men and toted across the rough coastal plain to the *Morrissey,* or else trussed up in a sling between poles and carried by two men.

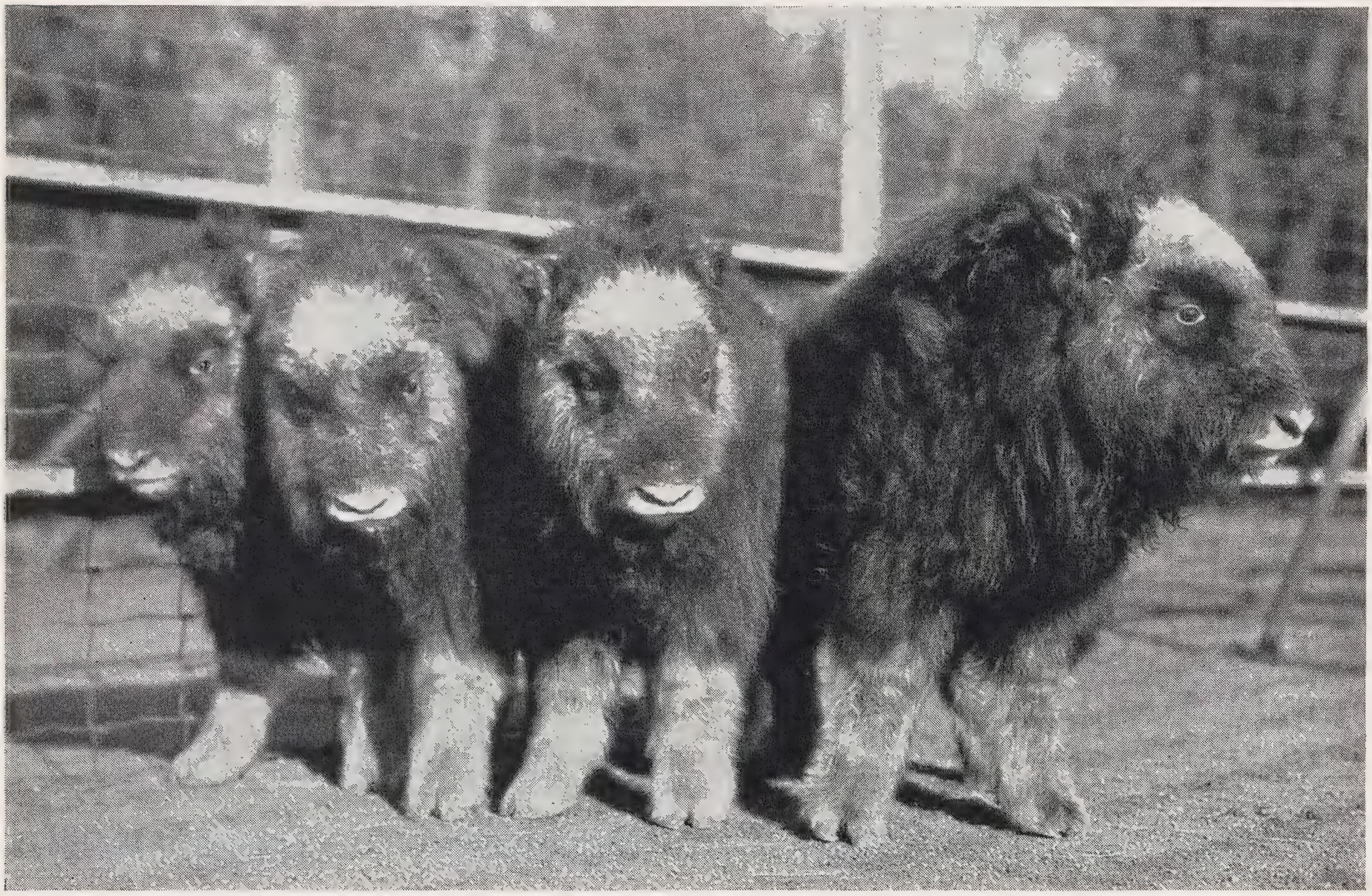
The muskoxen were confined in separate crates on deck, and one man was told off to take care of them.

"And he had his hands full," Captain Bartlett said. "I reckon he didn't leave those little devils for more than five minutes at a time for sixteen hours of the day. They were always hungry and they came pretty near eating us right out of the ship. Every time we got a chance, I sent a party ashore to bring back grass and willows for bedding and food. I wasn't too sure whether they were old enough for that kind of food, but they took to it all right."

By the time the young muskoxen arrived here they must have been approximately five months old, and they were far beyond the age at which a man could pick one up and carry it on his back. Dr. Goss weighed and measured two of them on November 1 and it was no easy task for two husky keepers to seize one animal and rush it into a crate that could be lifted to the bed of the scales. Tenacity is a major characteristic of muskoxen, and each of the two babies, when crated for weighing, kicked and snorted and lashed out at the sides of the box almost continuously. It was only during the flashes of stillness that the Veterinarian could adjust the weights and obtain a reading. One, a male, weighed 50.8 kilograms and a female weighed 50.3 kilograms—in each case approximately 110 pounds.

Their height and length were almost identical, too, varying only about half an inch in the two animals. Such a variation could easily be caused by inaccuracy in adjusting the measuring stick, for both calves plunged and bucked without a moment's letup. The measurements for both animals were: height at hip, 26 inches; height at shoulder, 26 inches; length from poll to end of body, 34 inches.

As each of the calves was weighed and measured it was half-carried, half-dragged to the door and released in the corral. In true muskox fashion, the instant it was free of restraint it galloped to the far side of the corral and then whirled to face the source of annoyance. When all four of the babies were in the corral at the same time, the two that had not been caught for measuring and weighing seemed to have become infected by the excitement of their companions,



Our newest babies—the four young muskoxen brought to the Zoological Park by Captain Bartlett. This pose is typical; at the slightest hint of interference by humans, the youngsters crowd together, heads out facing the source of "danger." Sometimes they will even charge.

for all four were bunched together, heads out facing the Veterinarian and his helpers, and all four were huffing and puffing. But, for that matter, so were the Veterinarian and the keepers.

Like all ruminants, whose four stomachs develop successively as they grow up, the muskox calves start life on a liquid diet and graduate to the harsher forage foods as their stomachs are ready to receive them. The babies were weaned to a grass and willow fare while still aboard Captain Bartlett's ship, and although Dr. Goss estimated that on their arrival here they were still quite small for anything but milk, they refused it at first and took readily enough to alfalfa hay, oats and vegetables.

At the present time they are getting a well-rounded diet that includes alfalfa, oats, codliver oil, yeast, carrots, cabbage, lettuce, apples and salt. Water is always available, and they have learned to drink from a bucket of powdered milk mixed with water. This they seem to take when they are thirsty, making little distinction between it and water.

Muskoxen are now, and probably always will be, important rarities in zoological collections. Dr. W. T. Hornaday stated the case succinctly in the *Bulletin* of September, 1902, when, discussing our first specimen—incidentally the first ever exhibited in the United States—he remarked that they were among the last of the world's large mammals to be brought into captivity because of "the difficulty of transporting the animals from the far North to civilization, and the universal doubt regarding their ability to survive in the temperate zone."

The difficulties of transportation are not insuperable, but since Dr. Hornaday wrote more attention has been paid to conservation of wild life in the far North and the export of calves is under regulation. The experience of the past forty years has shown that muskoxen live reasonably, or more than reasonably, well in the temperate zone; Major Stanley Flower, in his compilation of the longevity of captive mammals, cites one specimen of the white-fronted muskox that lived for ten years, two months and one day. The best muskox record among those exhibited here was made by a specimen that was received on November 14, 1922, and died on September 20, 1930—seven years, eleven months and six days.

Rare though the animals are likely always to be, none nowadays can command the intense interest that centered around the first specimen exhibited here. As has been mentioned above, Buffalo Jones came close to bringing back to us the first muskoxen ever to be exhibited anywhere in the world. The disaster that overtook his band of five calves in 1898 gave an opportunity to a Swedish Arctic expedition which in 1899 caught two male calves which eventually reached the park of the Duke of Bedford at Woburn Abbey and the Berlin Zoological Garden. Both of these were caught on Clavering Island adjacent to Hudson Land, only a few miles from the area whence our present specimens came.

The next shipment of muskoxen out of the Northland was destined for the New York Zoological Park. As Dr. Hornaday told the story in that *Bulletin* article of 1902——

"In March, 1901, Captain H. H. Bodfish sent out from the Whaling Steamer *Beluga*, then wintering in the Arctic Ocean, north of Great Bear Lake, a party of whalers and Eskimo hunters, for the purpose of capturing live Musk-Ox. About 30 miles from the coast the party encountered a herd containing four calves, all four of which were finally captured."

Three of the calves failed to survive, "leaving only one specimen, a female about one year old. This was successfully preserved, fed on willow twigs and coarse grass from the Barren Grounds, and finally brought to San Francisco.

"On reaching San Francisco, the little Musk-Ox was offered for sale at $3,000, and if the Western Union Telegraph Company did not declare an extra dividend because of the Musk-Ox telegrams that went hurtling to and fro across continents and under seas, it was not the fault of the senders. Eventually it came to pass that the animal was brought to New York, and offered to the Society for $1,600. The opportunity was reported to Hon. William C. Whitney, who immediately purchased the specimen and presented it to the Society.

"This animal is the greatest prize which thus far has entered the Zoological Park."

That animal, it must be noted, was a representative of the Barren Ground species of muskoxen, scientifically known as *Ovibos moschatus moschatus*. Two subspecies are recognized; *Ovibos moschatus niphoecus*, which is found about the head of Wager Inlet west to Baker Lake and

This is one of the six young muskoxen that reached the Park in 1910 *through the Rainey Expedition. Its horns were beginning to grow down and outward but had not yet developed the broad base so characteristic of the full-grown adults such as the one on the opposite page.*

on westward toward Great Slave Lake, its actual range limits and the place of its merging into the typical *moschatus* form being uncertain, and *Ovibos moschatus wardi* which is found rather widely in east and north Greenland. Since that first Barren Ground specimen more than thirty-seven years ago, all our muskoxen have been of the *wardi,* or Greenland, race.

Oddly enough, the flurry of excitement over the arrival of the first muskox had scarcely died down when a second specimen, from Greenland, was presented to the Zoological Park. Commander Robert E. Peary had captured it in northeastern Greenland and the Peary Arctic Club made a gift of the animal to our collection on September 21, 1902. The animal was not destined to add long glory to the Arctic explorer's name, however, for it died on October 25 of the same year as the result of injuries sustained in a fall. It weighed forty pounds at the time of its death and, judging from the weight of our present muskox calves, must have been a runt—if it had been born in the spring of 1902.

After that, no more muskoxen reached the Zoological Park until 1909 when one hefty specimen of 190 pounds came through the agency of Captain Bernier's Canadian Arctic expedition. The Rainey expedition brought back six in 1910, and then there was a lapse until 1921 when two animals were purchased. Five more were acquired in 1922 and two pairs of these produced, in September of 1925, the first muskoxen born in this country. Both were females and both died soon after birth, one in three days and the other in four. One of the babies was sent to the American Museum of Natural History for detailed study, and the second was mounted and since then has been exhibited in the Geographic Hall of the Museum of Heads and Horns.

Again in 1929 we received four young muskoxen, and Captain Bartlett's group of four this autumn brings the total to twenty-six over a period of thirty-seven years.

* * *

The muskox occupies an unusual position in the animal world, which its scientific name some-

Another of the Rainey Expedition specimens, at the age of about five years. This animal established our second-best longevity record for muskoxen, living for seven years, five months and eighteen days. The record anywhere is ten years, two months and one day.

what expresses. *Ovibos moschatus* comes from the Latin *Ovis,* a sheep; *bos,* a cow; *moschatus,* musky. It belongs to the family of cattle-beasts, the Bovidae.

"While it is not, strictly speaking, a link between the 2 families of sheep, on the one hand, and cattle on the other—a relation indicated by its scientific name—it nevertheless combines anatomical and other characters belonging to these 2 large groups," one scientist wrote[1], and Ernest Thompson Seton remarked that "It is nearer to the American Buffalo in anatomy than to any other existing animal; and may be described as a form of Buffalo specialized for life on the Polar Plains[2]."

Fossil remains of the muskox have been found in Europe, Asia and North America, and appear to be identical with the living species. Those ancient muskoxen flourished in Pleistocene times and, because they were equipped for Arctic life, they followed the retreating ice into the northland, while the mammoth and the woolly rhinoceros that were their contemporaries were unable to adapt themselves to changing conditions and have vanished, along with most of the other larger Pleistocene mammals. Toward the end of the ice age the muskox was circumpolar, occurring in Europe along with the last Neanderthals and the Cro-Magnon men.

Animals and plants which were formerly widely distributed but now merely occur in small sections of their earlier range are called relics by the naturalist, and the muskox is a typical mammalian relic.

Fossil remains have been found as far south, on the North American continent, as Indiana and Iowa, but living animals are today confined to the far northern reaches of Canada and Greenland. It would appear that they died out in northern Europe and Siberia and survived on

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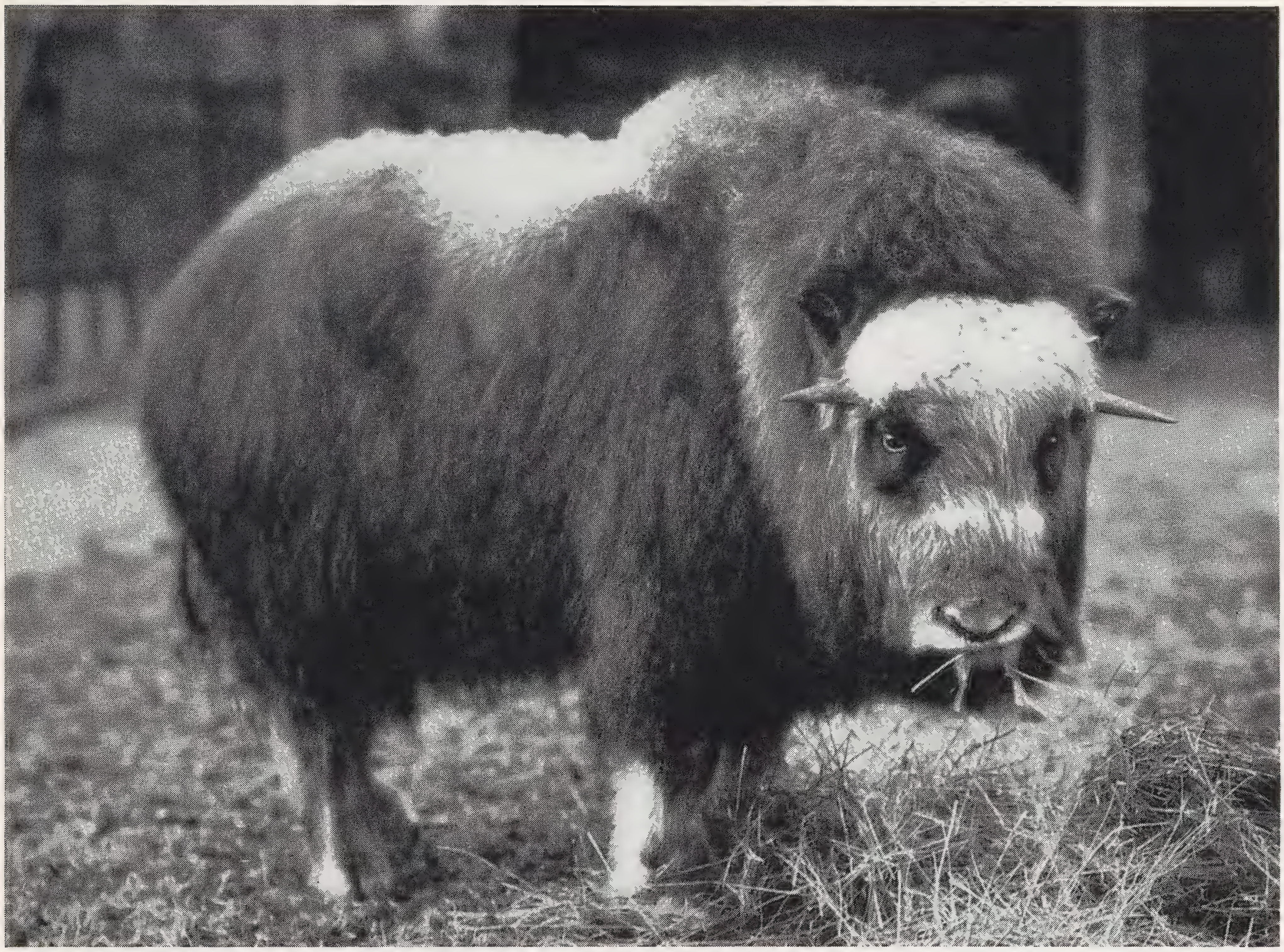
[1] Hewitt, C. Gordon. The conservation of the wild life of Canada. New York, 1921.

[2] Seton, E. T. Lives of Game Animals. New York, 1927. Most of the information about the natural history of the muskox in the remainder of this article has been abstracted either from Seton's "Lives" (Vol. III) or Special Publication of the American Committee for International Wild Life Protection, Number 5: "The Present Status of the Muskox," Cambridge, Mass., 1934.



The white patch on the back of the muskox, which has often been remarked as an excellent camouflage for the animal when it is resting—making it look like a small hillock—shows well in this picture of one of the young animals received in 1921. *It is still in the "spikehorn" stage.*

this continent because the great north-south extension of land here aided them in following the retreating ice northward.

Certainly a slow, gigantic migration must have taken place during the fading out of the ice age, but today the muskox is not considered a migratory animal. Most modern observers agree that it prefers to remain indefinitely in areas where food is available. Individuals or herds graze quietly, much like domestic cattle, and move only as food conditions make it necessary. They do, however, make local movements that may be in response to food or weather conditions. Apparently in severe winter weather herds or individuals will travel some distance to seek the shelter of ravines or broken land.

Open water is a barrier to any extensive roaming, for the muskoxen are said to be very poor swimmers. Indeed, Indian hunters are said to drive them into lakes in summer time, and then to pursue them in canoes, since the animals are at a great disadvantage and can move only slowly.

The traditional belief that muskoxen eat moss and lichens chiefly or exclusively has been thoroughly disproved by many observers. The belief apparently stemmed from an impression of more south-dwelling writers that the far North is always a barren land where nothing but moss and lichens grow. Actually, grass, willows and creeping plants are widespread in summertime in the muskox territory, and these are the animals' chief food. Only occasionally have they been found eating lichens and "reindeer moss"—generally at times when other food was not available in quantities.

Dried grass or willow browse can be found even in winter when the snow lies deep, for the muskox is adept at scraping the snow away with his hooves, and he uses horns and nose as auxiliaries. Frequently, too, the snow is swept from vast areas by the wind, and food in plenty lies within easy reach below the icy crust.

Man is the greatest enemy of the muskox, as of so many other wild animals. It has come to be an axiom of conservationists that muskoxen and Eskimos cannot occupy the same territory, for the Eskimo seems incapable of refraining from killing far beyond his needs. Usually an encounter between Eskimos and muskoxen results in the entire herd being slaughtered, and the meat taken from perhaps one or two animals. And then, when another hard winter comes and the Eskimos are unable to find muskoxen, they explain that magic has been at work, and the muskoxen have left the country!

Wolves are another traditional enemy, although if they alone were to be considered the muskox would certainly survive very well. However, wolf-trapping has been carried on vigorously in East Greenland, and observers profess to be able to see an increase in numbers of muskoxen in the trapping areas in the past few years. Whether trapping alone is responsible no one knows for sure.

The habits of the animal are in large measure responsible for its easy extermination when marauding Eskimos or white hunters attack it. The point has been made, and vigorously, by many writers that hunting muskoxen is not to be considered a sport, for the animals allow themselves to be slaughtered with scarcely no more effort than loading a gun and firing. When a herd is attacked, usually with dogs as the skirmishers, its members make a short run and then form a rough square or circle, heads out. Now and then an individual will break out of the circle to chase a particularly annoying dog, but as a rule they will stand quietly. Hunters can draw close, and if they aim effectively and make a clean kill each time, they can shoot down the herd one after another.

In recent years the Canadian Government, through the agency of the Royal Canadian Mounted Police, has undertaken rigorous protection of the muskoxen in its territories. They may be killed legally under no circumstances, although it is known that a few occasionally fall prey to hungry Eskimos and white travelers. In Greenland, there appears to be no official protection by the Danish Government comparable to that which Canada has imposed, but export of calves is subject to license, and those in the southern part of the range enjoy a certain amount of protection.

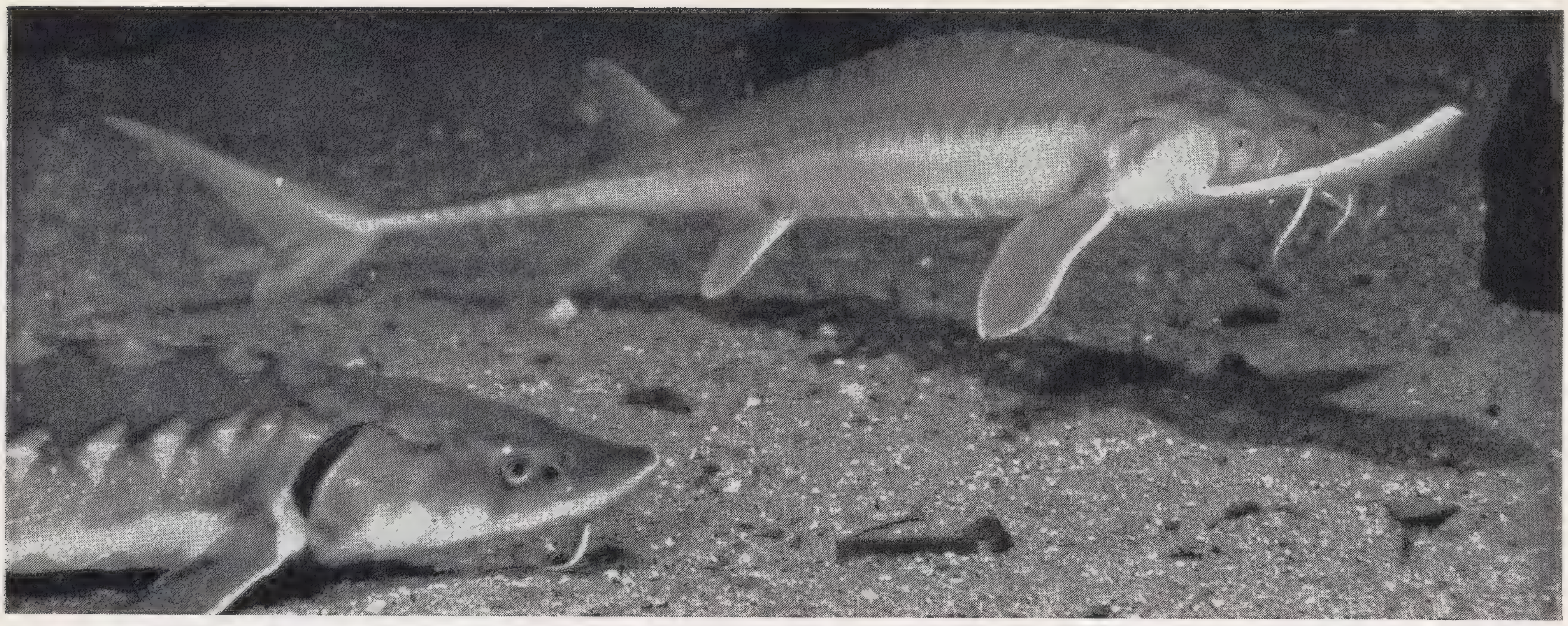
About ten years ago an experiment of introducing muskoxen into Alaska was tried, and such reports as are available indicate that it has been moderately successful. Other transplantation experiments to Norway and Iceland in the past fifteen years have met with varying degrees of success.

It appears from these experiments that while the animal can be reestablished in many of its former haunts, it is doubtful whether it can be domesticated, and it is uncertain whether its economic value is great enough to justify building up greater numbers than are necessary to maintain the species. Natives of the northland find many uses for the hides and sinews and other parts of the muskoxen, as well as the flesh, but the inability of the animal to withstand domestication hampers efforts to establish herds.

The meat—to the palates of most white travelers in the North, at least—suffers from a musky taint. In texture the flesh is much like that of beef, and there are layers of fat on the neck when the animal is in good condition. The musky flavor is strongest in old bulls and least in young calves, strong in lean animals and scarcely perceptible in fat individuals, according to some reports. But all muskoxen have the taint to a certain extent.

Seton's comment on muskox meat is illuminating:

"On several occasions in the August of 1907, I made a meal of Muskox beef. The musk was scarcely noticeable during the meal. But afterward, for hours, I had strong and unpleasant reminders of the experiment."



The shovel-nosed sturgeon, Scaphyrhynchus platorhynchus, *is a species that is valued for food, but now is found only in greatly reduced numbers. The related Atlantic sturgeon,* Acipenser oxyrhynchus, *showing somewhat similar characteristics, is seen in the lower left.*

A Collection of Fishes from Illinois

The Aquarium's Fresh Water Section Shows a Wonderful Improvement, with Clear Water and Many New Specimens

C. M. BREDER, JR.

NOW that the temperate fresh water in most of the Aquarium's tanks has been cleared of its former turbidity, specimens in that section can be seen once again by both the public and the employees. The condition now so happily corrected was caused by suspended clay in our water supply and, although harmless otherwise, it practically nullified our efforts to exhibit temperate fresh water creatures. By a system of filtration, sedimentation, coagulation and similar technical manoeuvering in which the water is used over and over, it has become crystal clear. The basic mechanical elements were installed largely through the agency of the Works Progress Administration. In addition to giving us visually satisfactory water, the saving to the City in water consumption has been increased to a maximum. In ordinary usage this closed system of circulation demands only additions from time to time to make up for evaporation.

Before this correction of an unpleasant condition was effected, there was little point in trying to maintain a large collection of temperate water fishes that no one could see. But as the work progressed, we anticipated the improvement and knew that it behooved the staff to extend its collecting activities in this long neglected direction.

Naturally, we must do more than exhibit merely such fishes as are to be found in local streams and ponds. Since the Mississippi drainage supports a variety of fish life not known on the Atlantic seaboard, we sought a supply of fishes from that area.

We were exceptionally fortunate in being able to enlist the help of the Illinois Natural History Survey in this matter. The time, trouble and effort that this group undertook in our behalf is one of the high points in my personal file of memories of human relations. Under the sanction of Dr. T. H. Frisen, chief of the Survey, Dr. D. H. Thompson, head of the section of aquatic biology, went to so much trouble to see that we had satisfactory working conditions and access to the places he knew from a collector's standpoint, that I almost dislike thinking of the sense of obligation I feel! Not only did Dr.

Thompson give freely of his personal advice and services, but nearly all the various members of his staff were involved in one way or another. For fear of overlooking one, perhaps it is better that all these useful people remain under the anonymous blanket of "staff."

If everything in Illinois were as satisfactory as our relations with this group of scientific investigators, we probably would have had more fishes that we could carry. However, the river was in a strange mood and the weather was all wrong for our job, even if exquisite for general personal comfort. Rains had failed and by the time we got into the field Old Man River was a very feeble trickle. In fact, the older river folk had difficulty recalling just when the river had been at such low ebb. Navigation was seriously hampered. This, under many conditions, should make the catching of fishes by nets an easier task, since the individuals are necessarily closer together—fewer cubic feet of water per fish. However, this concentrating effect was modified by an unseasonable and protracted warm spell. The shallower shore waters, being naturally warmer than the deeper and less accessible holes, in many places were nearly devoid of fishes. They apparently were concentrated in the cooler deep spots, relatively safe from our attempts to corral them. Another unfavorable feature the high temperature engendered was that fish were too active and alert to be handled with ease. Fishes well chilled are much less liable to injury to themselves by virtue of their lessened amount of struggling and more quiescent behavior.

Although the above sounds rather dismal, and it must be admitted that we were disappointed by being unable to obtain certain items for which we had hoped, nevertheless the collection of 804 specimens of 32 species has helped to make the newly revived temperate fresh water collection thoroughly presentable.

Some of the accompanying photographs show various specimens that are now on exhibition as a result of these activities. In order to amass this collection, it was necessary to cover a wide area. Ten days were spent in Illinois by Mr. H. E. Dixon and myself. A good part of the time we covered different territories. In all, three automobiles of the department and its houseboat were used in our collecting efforts.

Shovel-nosed sturgeon were collected at the extreme southern tip of the state, where the Ohio and Mississippi join, while various small minnows were collected near Urbana and other species at numerous points between. This represents a north and south distance greater than that between New York City and Richmond, Virginia. From east to west practically the width of the state was covered.

Fyke nets, seines of various sizes, and set lines were all employed, depending on the circumstances and the specimens we were attempting to collect. The containers were all aerated by means of small air pumps during their transportation, and every effort was made to see that the collection arrived in New York in the best possible condition.

Finally, when the collection was assembled, it was transferred to a large truck hired for the purpose and sent on with all speed possible to the Aquarium. As this is being written, the collection is still being sorted and the specimens are finding their places among the older residents with which only recently have we ourselves been able to make a real acquaintance in the clear water of their tanks.

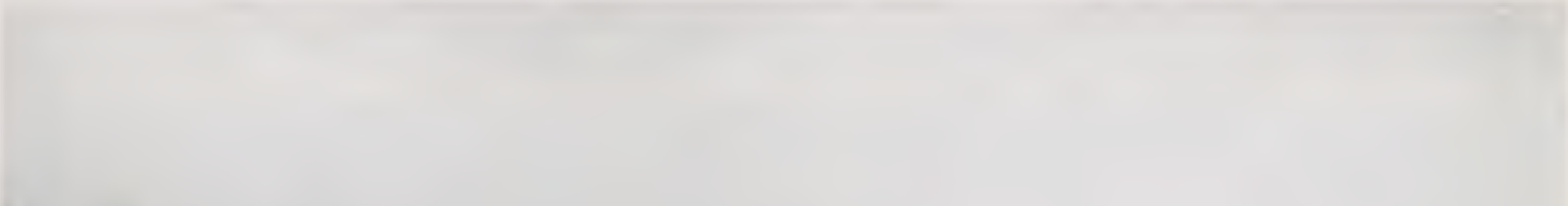
A goodly proportion of the Aquarium's visitors is made up of people from inland areas. Since no inconsiderable number of these are citizens of Illinois, it is only proper that we let them see their native fishes along with species from distant places. Naturally enough, the inland resident usually asks first for the more well-known and spectacular marine forms—seahorses, sharks and other widely publicized ocean dwellers. After this primary interest is satisfied, the next question is usually about home fishes that the visitor generally knows only as an angler or gourmet. Disappointment is frequently ill-concealed if some favorite is not frisking about in one of the aquaria. While we cannot always exhibit every fish that visitors ask about, we do try to keep as representative a collection as possible—and this new collection from Illinois is a step furthering that objective.

The photographs of fishes in their new quarters taken by S. C. Dunton, give testimony of the clarity of our revived fresh water system. Formerly it was impossible to take any kind of reasonable photograph of the fishes inhabiting this water.

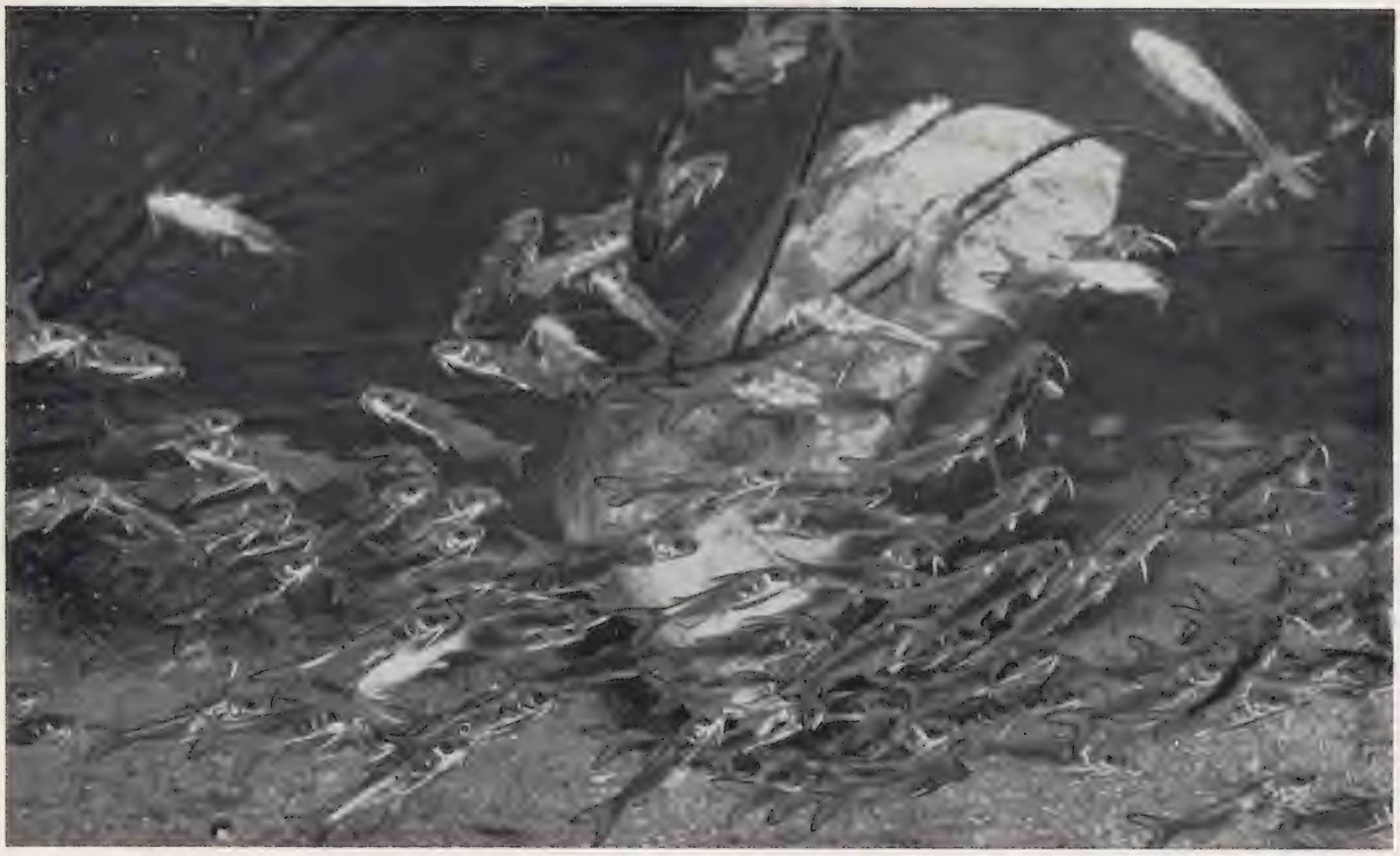
When the collection of Illinois fishes had been made in the field, small trucks of the Illinois Natural History Survey picked up the specimens and transferred them to the huge transport truck which carried the entire shipment to the Aquarium in New York.

Trap nets were an effective means of catching small fishes in the backwaters of the Illinois River. Here the specimens are being sorted out preparatory to shipment to the East. The work of sorting and classifying is still going on at the Aquarium.

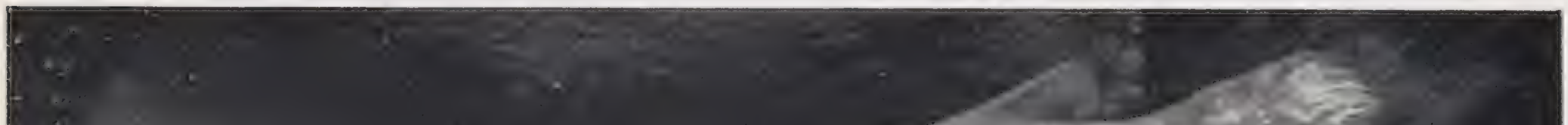
In working some types of streams to collect fishes, the more hands—and feet—the better. The assistance of a class from the University of Illinois on one of their collecting trips near Mahamet was helpful. Here the students are "wading out" several kinds of small fishes.



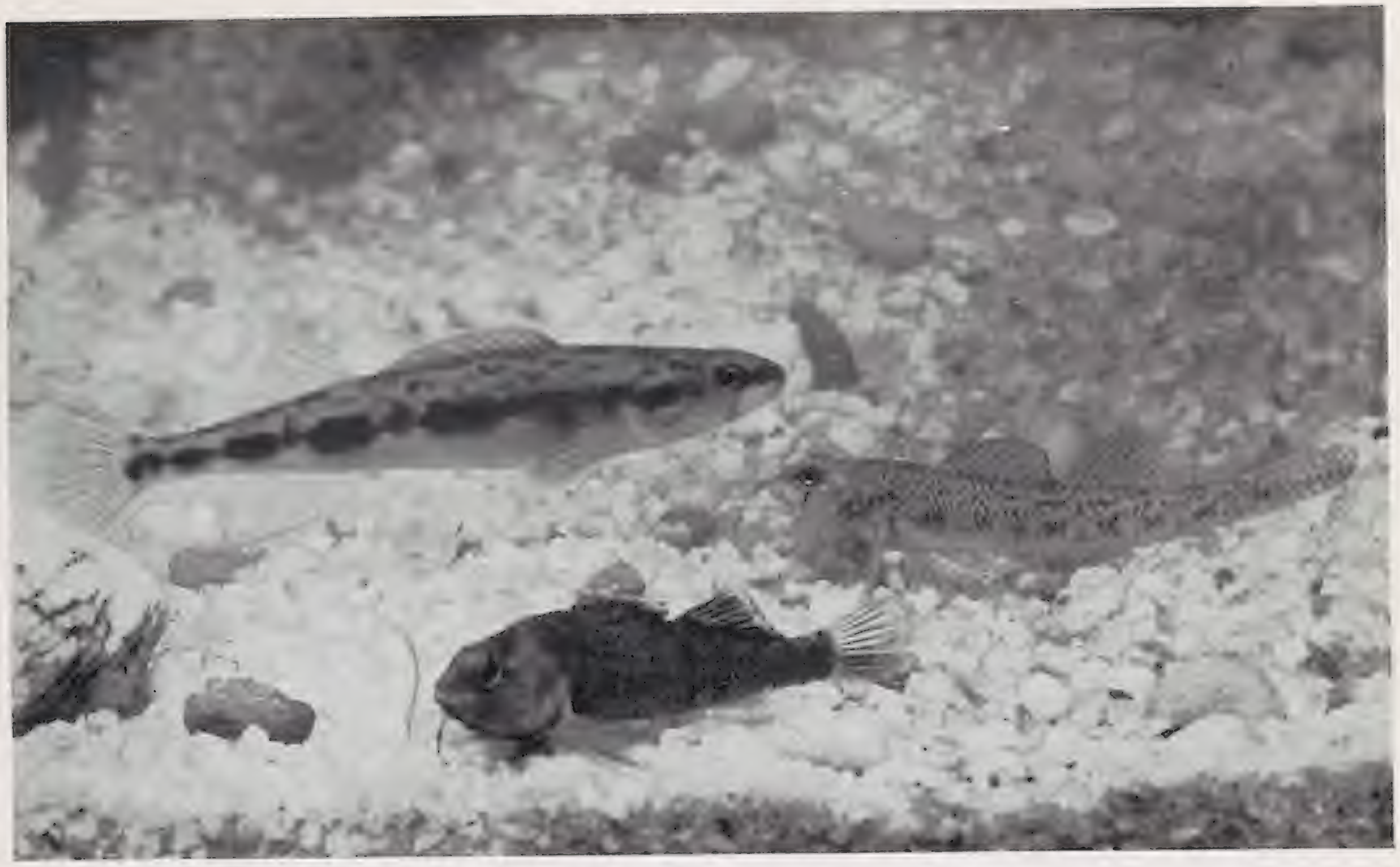
The Mississippi River was at a particularly low stage all through the collecting period. At this point, above the town of Chester, the beach marks may be seen clearly. Already invading vegetation has sprung up on the rich bottom land on all except the most recently formed beach.



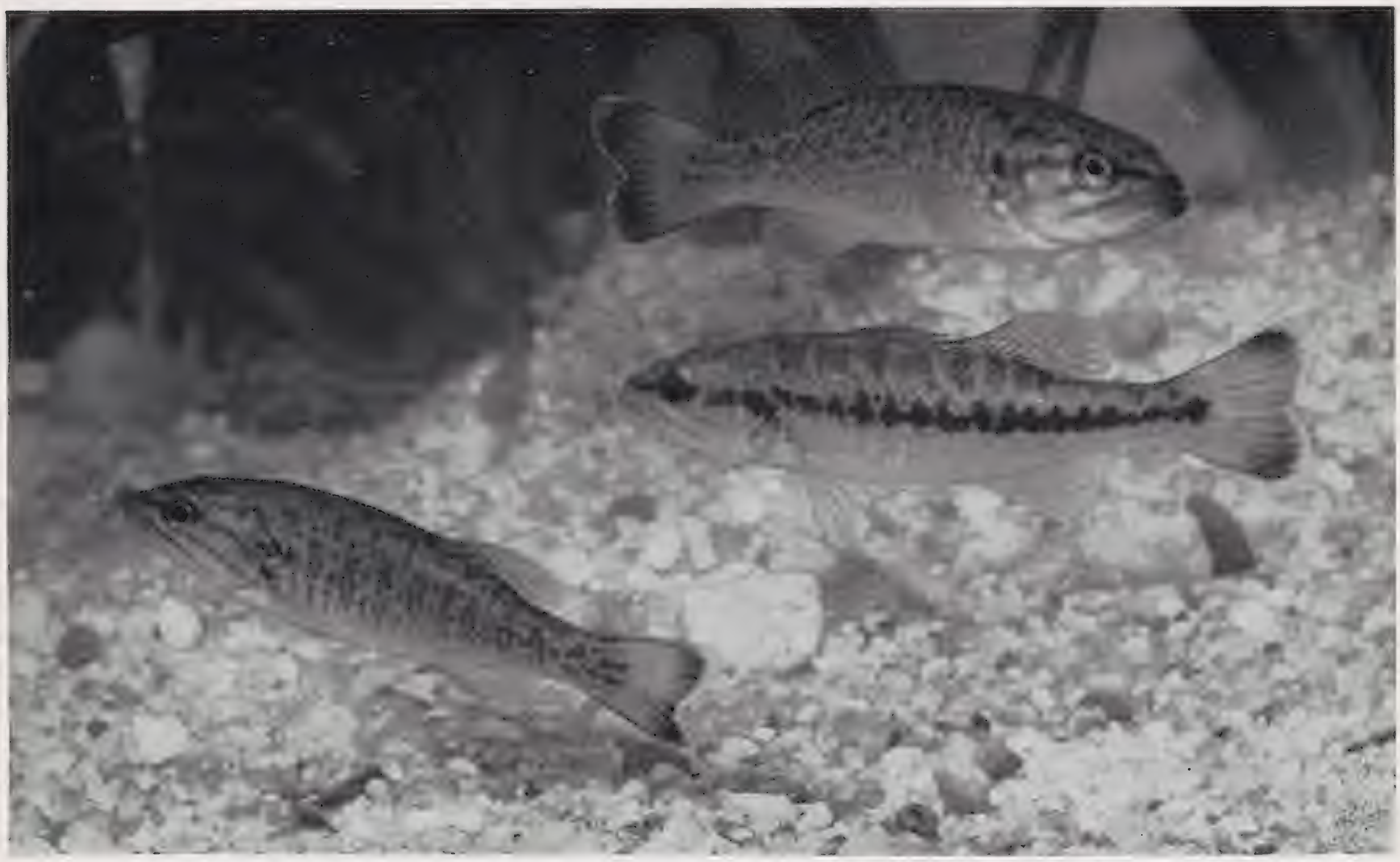
A school of young spotted catfish, Ictalurus punctatus. *These fish were hatched last spring and do not as yet show their full adult characters. Considerable numbers of them were caught.*



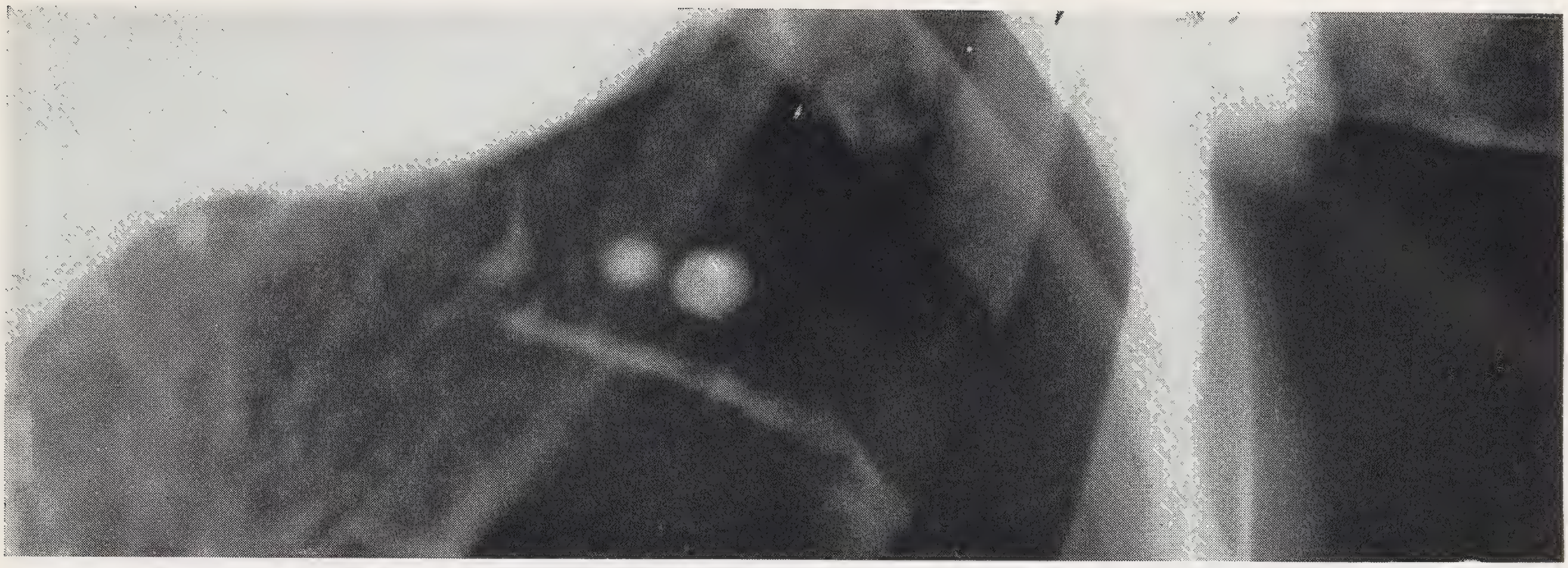
The blue catfish, Ictalurus furcatus, *from the Illinois River, looks very much like the spotted catfish, but the spots readily distinguish the latter at this stage of their growth.*



Three species of darters from Illinois. Foreground center, rainbow darter, Etheostoma caeruleum; *left, black-sided darter,* Hadropterus aspro; *right, Johnny darter,* Boleosoma nigrum.



Young Kentucky bass, Micropterus pseudoplites, *and a young large-mouthed bass,* Aplites salmoides (*center*). *The former were first described in* 1927 *and are new to the Aquarium.*



Courtesy St. Luke's Hospital

The two small white circular spots in this X-ray of a human lung are the coiled and perhaps encysted parasites of Porocephalus, *which is most commonly found in certain snakes.*

Snake Parasites in a Man

An Uncommon Case in a New York Hospital Leads to Research in Our Laboratory on the Life History of *Porocephalus*

LEONARD J. GOSS

MANY research problems in the Hospital and Laboratory of the Zoological Park have an indirect bearing on human diseases, but the connection is seldom as direct as one in which Dr. Carlton M. Herman, our research associate in parasitology, is now engaged. It came about through the curious case of a patient in a New York hospital whose lung was found to be harboring a parasite which usually occurs in snakes.

The case came to light during the fall when Dr. Henry S. Patterson of St. Luke's Hospital wrote to Dr. Ditmars. During the examination of one of the hospital's patients, a man, an X-ray picture of his chest revealed objects in the lung which were subsequently identified as the parasite *Porocephalus* sp. Published reports of similar cases are rare, but they all had one thing in common—the human host of the parasite had handled numbers of snakes. The hospital patient gave a history of having captured and handled large numbers of rattlesnakes and moccasins in Tennessee.

Dr. Patterson suggested that further light might be thrown on the matter if Dr. Ditmars and the staff of the Reptile House were X-rayed, to determine if they, too, had picked up the parasite in the course of years of work with snakes.

To date only Keeper Taggart has had an examination made. The X-ray picture of his lungs showed no parasites. Dr. Ditmars and Head Keeper Toomey will have similar examinations later.

Dr. Herman became interested in the matter at this stage. He is chiefly concerned, in helping to guard the health of our animal collections, with parasites that can be transmitted from one animal to another. Naturally, a parasite that can be transmitted from snake to man is not only fascinating to a parasitologist, but important to human as well as veterinary medicine.

Dr. Herman and Dr. Eric Ryan, chief of the X-ray section of St. Luke's, are now collaborating in an effort to find out something about the life cycle of *Porocephalus,* the method of its transmission from snake to man, and its effect on the ophidian and human hosts.

Practically nothing is known about the pathology of the parasite either in snake or man, almost equally little of its life cycle in the snake, and nothing at all about the means of transmission.

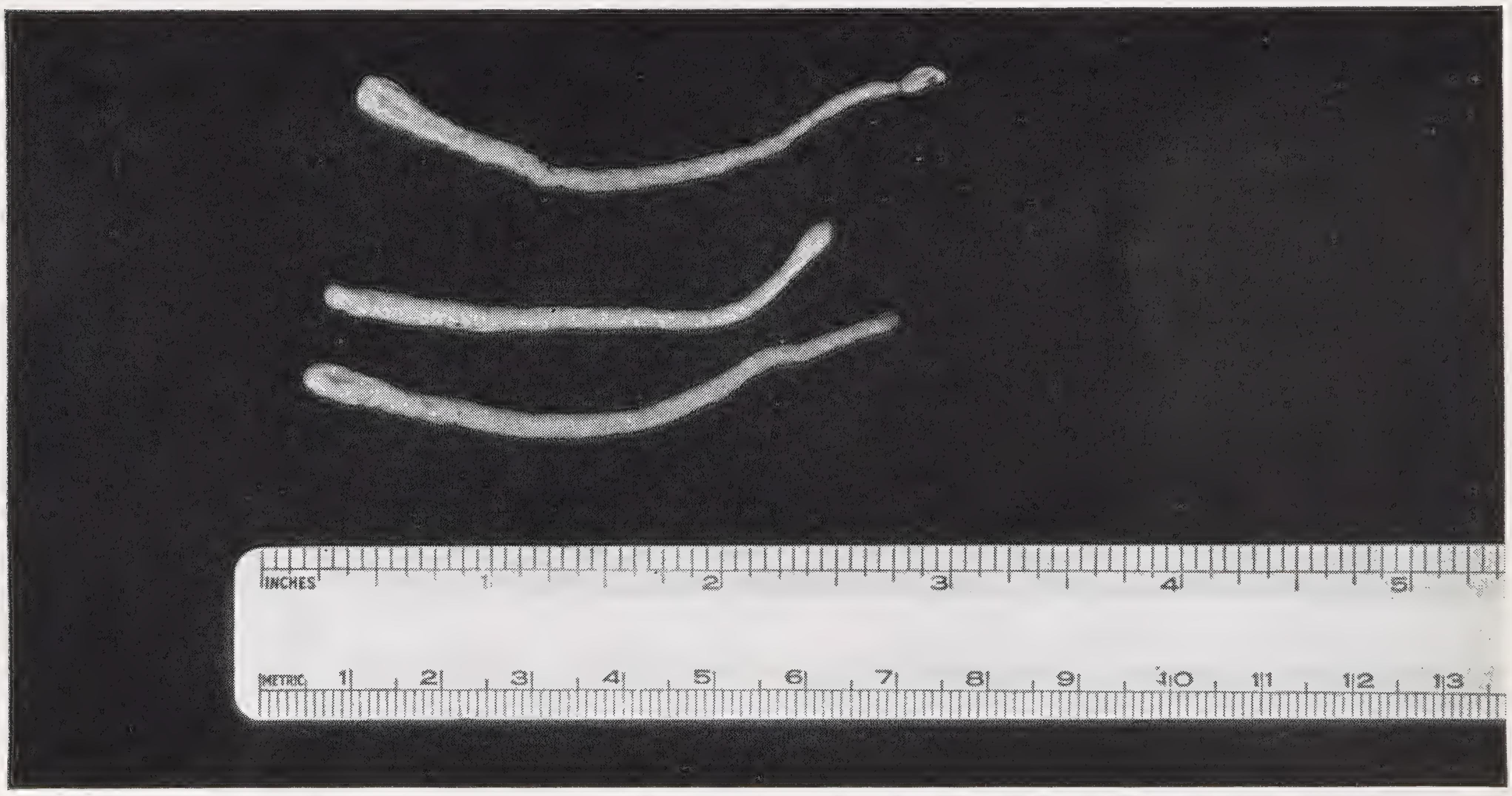
Porocephalids are encountered with fair frequency in certain of the snakes that reach our Laboratory for autopsy. They are most common in the South American boa (*Constrictor c. constrictor*)—at least a third of the specimens harbor the parasites. Usually there are one or two of them, but sometimes as many as half a dozen, in the lungs or, more rarely, in the body cavity. Superficially they seem to do the snake no harm, at least in light infections. Certainly they were not the primary cause of death in any of the snakes examined in the last two years.

Porocephalus is a primitive type of parasite belonging to the Class Pentastomida—a worm-like organism but not a true worm. By analogy with another parasite, *Trichinella,* it is possible that when it enters the human lung it is calcified and walled off. However, in snakes in which we have found it, it was always free and living. This might be because the snake is its normal host and the parasite and host have a natural adjustment to each other whereby the parasite is able to resist calcification in the snake.

In investigating the life cycle of the parasite, Dr. Herman has started by having X-ray pictures taken of six snakes now in the collection, of species in which *Porocephalus* has often been found. These were three South American boas and three Indian rock pythons (*Python molurus*). On two of Dr. Ryan's X-ray plates were found shadows suggesting that two of the boas were infected by porocephalids. Later, when the snakes come to the autopsy table, the diagnosis can be made certain, for as yet the investigators have had too little experience with X-rays of snakes to be certain of the meaning of the shadows.

If the X-ray does prove to be an accurate means of diagnosing porocephalids in snakes, the next step in the investigation will be to accumulate two groups of snakes, one known to be parasitized and the other known to be free of the organisms. The method by which *Porocephalus* is transmitted from one snake to another can then be worked out by experiment and the intermediate host, if any, determined.

These experiments may take a considerable time, but if the result is what we hope—a fuller knowledge of the life cycle of *Porocephalus* and especially its relation to man—it will be a most interesting contribution to medical science.



These three specimens of the parasite Porocephalus *were found in a South American boa that came to the Laboratory for autopsy. In the human lung they are probably walled off.*

Day and Night in the Life of an Armadillo

Our Giant Specimen's Keeper Is Trying to Turn the Hours Topsy-turvy for the Benefit of Visitors, by a Change in Feeding Time

William Cully
Keeper of the Kangaroo House

IN exhibiting nocturnal mammals, the one difficulty we are always confronted with is—how can we make them diurnal, active in the daytime, so that visitors can see what they really look like? With some, such as the giant anteater and the wombat, we have always been successful in changing their habits by a careful shifting of their feeding schedules. For some time past we have been experimenting with the giant armadillo and feel that the experiment has been a partial success. It is a long, drawn out affair, for the animal's health must be considered before anything else. But the many evenings I have spent in observing the armadillo make me sure that its habits would be interesting to every visitor and that they are well worth the effort of changing the animal to a daytime schedule.

Indigenous to South America, the giant armadillo has accepted our hospitality without complaint. It did escape once, but that was before we realized its extraordinary ability to climb, and the full extent of its nocturnal activity. When our present specimen arrived, in a strong wooden crate, on May 2, 1937, we had had a disastrous experience with a giant armadillo the previous year and had learned that our regular cages would not safely house such expert climbers. We had to plan some way to prevent the newcomer climbing up the front of its wire cage, and our precautions were taken before it was removed from the crate.

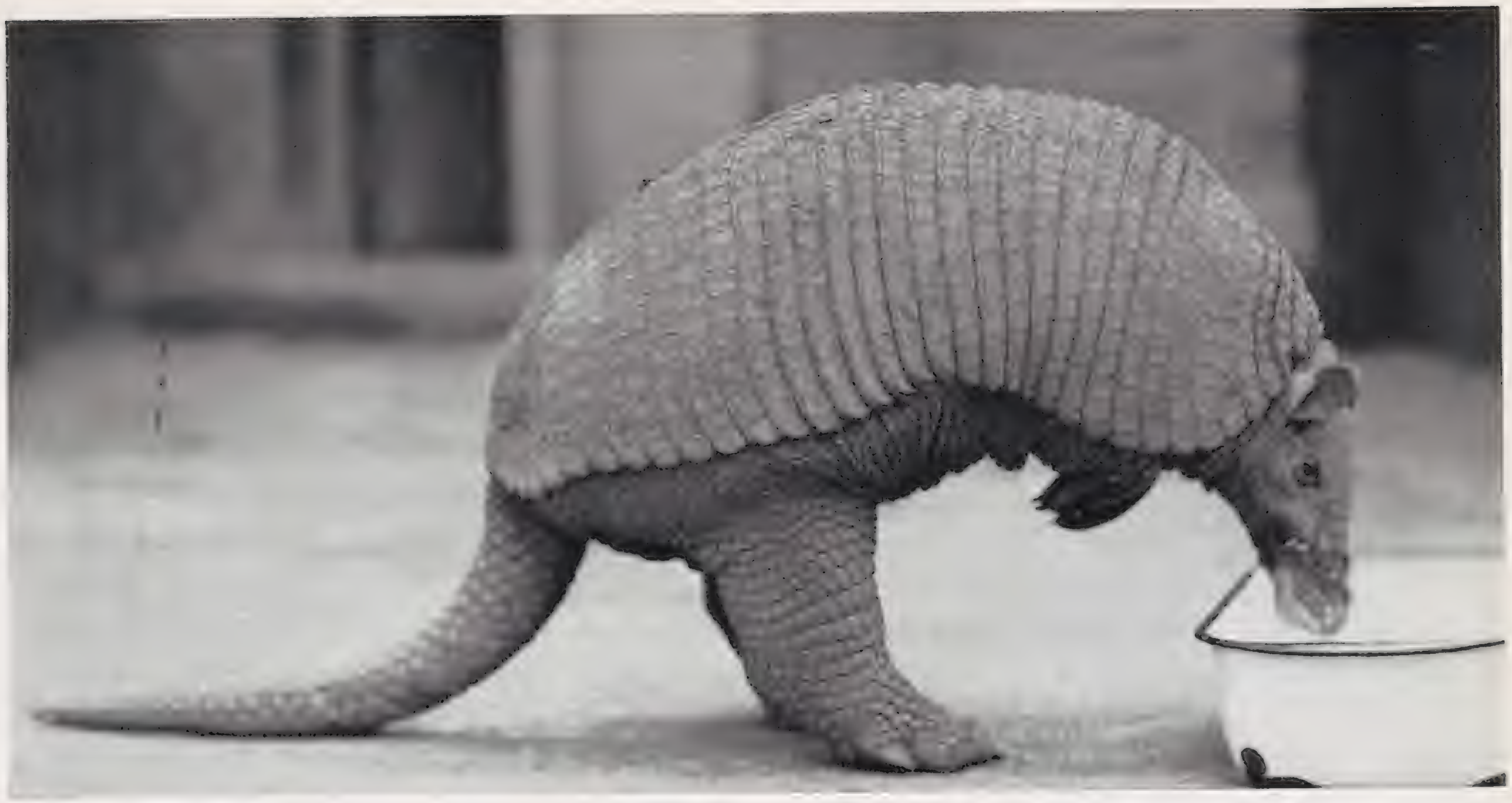
A row of one-inch steel bars five feet high, spaced three inches from center to center, were placed three feet back from the wire screen front of the cage. This barrier offered no hold for the armadillo's strong claws and solved the escape problem, but it has aroused almost as much curiosity among visitors as the animal itself. Countless times I have been asked, "Why do you have bars as well as wire in this cage? Is the armadillo a dangerous animal?" Invariably the visitor is astonished to learn that the armadillo is a remarkable climber and that the bars are not only to keep it from escaping, but to prevent it climbing and possibly falling, with a certainty of injury or death.

Anywhere between 9 and 10 o'clock each night the giant armadillo arouses from its deep sleep. Usually it begins the evening by a slow walk around the cage, sniffing and giving it what appears to be a general inspection. Quite frequently it walks in an upright position, using only the "pigeon-toed" hind feet. While the animal does use the front claws for walking, nature obviously designed them to be most effective for digging.

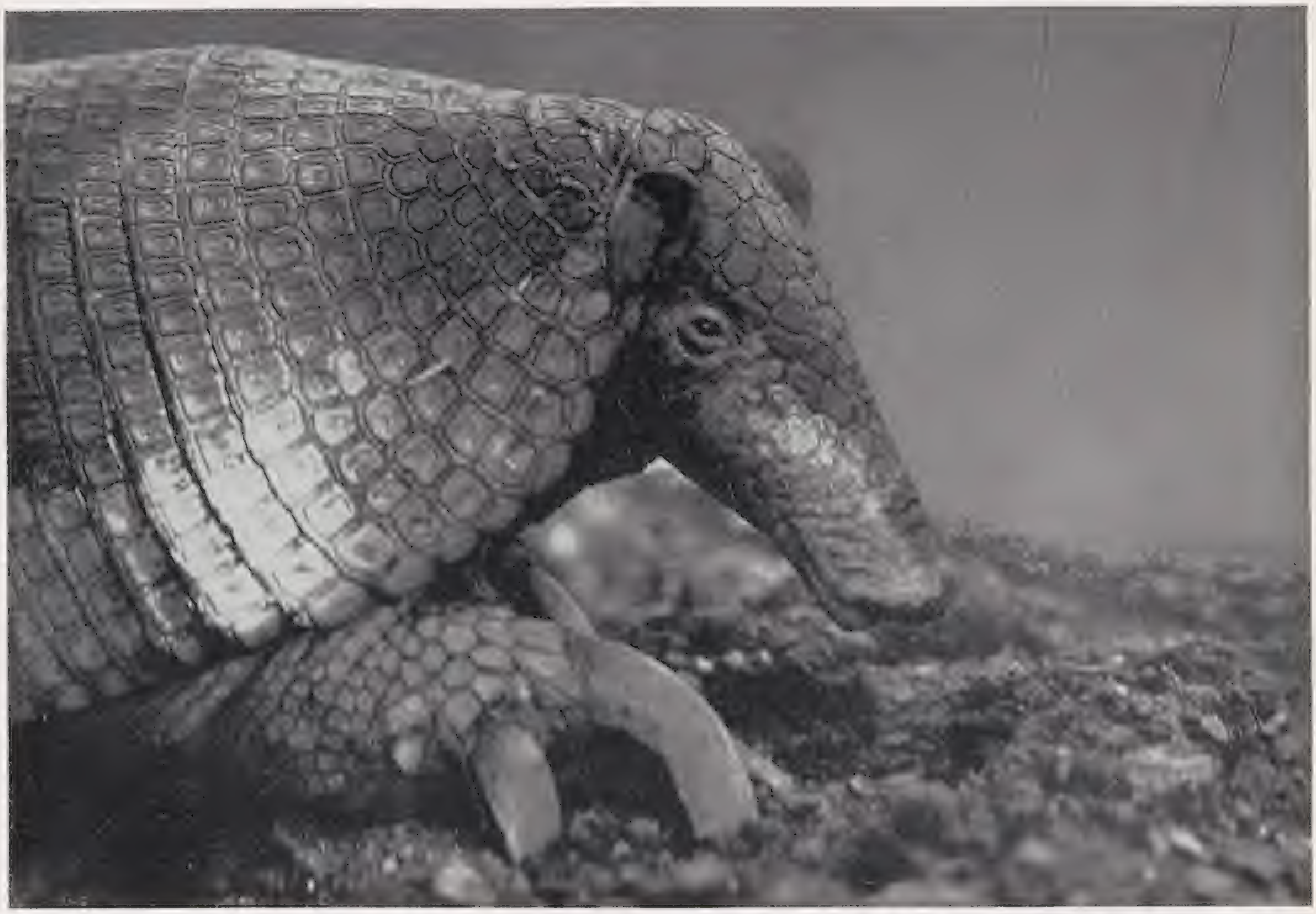
After inspection is over, the armadillo begins its nightly dozen on the bars. It will lie perfectly flat on its belly, front claws extended. Then the left claw reaches across to the right to clasp a bar. When the curved claw has caught the bar, the animal will pull hard and do a complete side turnover, landing back on its belly. This performance is continued along the entire front of the cage, a distance of ten feet. When the steel side wall is reached, it reverses and starts back to the other side.

The floor of the cage is covered with eight inches of soil, so there is never a chance of it cutting its back during these rolling exercises. While the shell of the giant armadillo has the appearance of being as hard as the shell of a tortoise, it is really quite easy to puncture, and bleeding results immediately.

After the performance with the bars, the animal starts on the shifting-doors of its cage.



Some idea of the size of the giant armadillo can be gained from a comparison with the large pan in which its food is offered. In this pose it would seem that the animal is formed like a kangaroo, with tiny forelegs, but in reality the forelegs are quite stout.

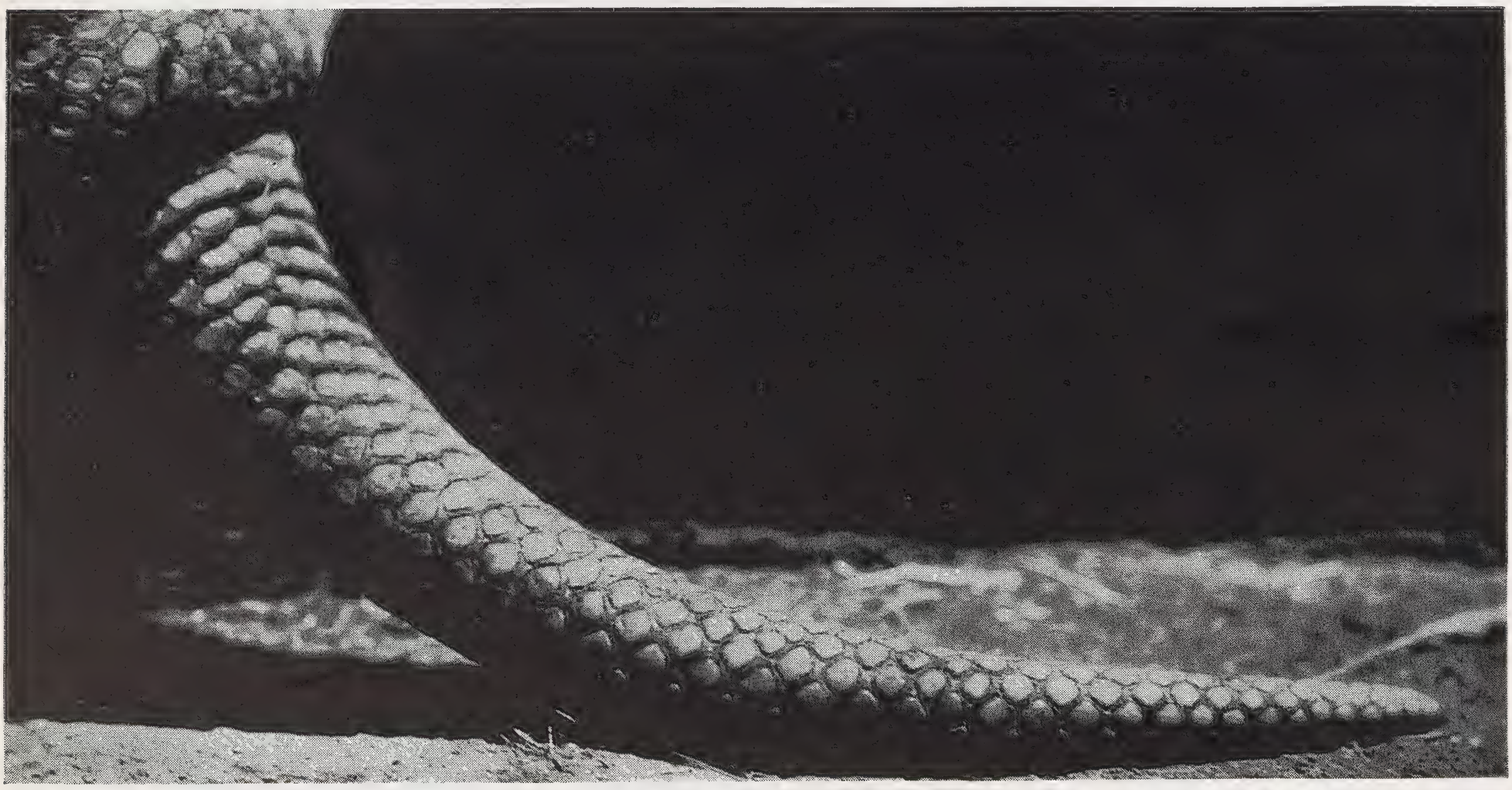


The strong digging claws on the forefeet of the giant armadillo are almost equally effective as implements and as weapons. These it uses literally to plow up the ground in search of ants and grubs,and the keeper must beware of their blows in handling the animal.

It will insert its claws in the side of the steel door and pull until its body is brought down in contact with the steel side of the cage. In this position the great strength of *Priodon giganteus* is put into play. All the powerful muscles can be seen working with the precision of machinery, and the tail slaps against the steel wall with a force that reminds one of a pneumatic hammer. The building begins to sound like a boiler factory, yet never has the tail suffered from this constant pounding. After a few minutes of this exercise, *Priodon* walks to the bars at the front of the cage and, standing perfectly erect, proceeds to sharpen its front claws by drawing them down the bars. Then it starts digging. As fast as the dirt is loosened by the front claws, the hind feet are busy in pushing it away. Here is intense action—action that we hope to be able to record in moving pictures some day.

As daybreak begins, the almost incessant activity of the night begins to slow down. The armadillo gradually makes a complete circle. The head is slowly pulled under the shell, then the tail follows; in the meantime, the circling motion is continuing. The most remarkable feature of this roundabout route to a well deserved sleep is the way the animal slips its hind feet over its tail while making the circle. This it does without touching the tail, and so well is it timed that unless one keeps a careful watch the performance will not be seen. When it is completely rolled up like a ball, all signs of activity cease.

The giant armadillo weighed 68 pounds on arrival, and today its weight is approximately 110 pounds. It is fed once a day. The food consists of three pounds of raw chopped beef, five raw hen eggs, one quart of evaporated milk, one quart of tepid water and one pint of tomato juice. All these ingredients are mixed together, and when the animal begins to eat, there is no stopping until the feed pan is perfectly dry. We hope that eventually, by gradually changing the feeding time, the animal will become more active during the daytime. During its first six months with us, the feeding hour was 4 P.M. In the next six months it was advanced to 3 P.M., and so on, until today the armadillo gets its combined breakfast-luncheon-dinner at 11 A.M. This change in feeding time has not affected its health and noticeably is making it more active in daytime when visitors are in the building.



The tail of the giant armadillo is truly an armored appendage and seems well able to withstand thumping blows against a steel wall during the animal's nocturnal exercises.

World's Fair Experiences

Visitors at the Society's Building, "Zoological Wonders," Learned a Great Many Things, and So Did We

FAIRFIELD OSBORN

IT is the evening of the closing day at the Fair, my ear still feels the impress of the telephone receiver and echoes with the cheerful voice of one of our staff (the staff in our World's Fair building always seemed cheerful!) who informs me that the 238,135th visitor has just passed through the turnstile.

It is the hour for review—for an appraisal of what this enterprise has accomplished, what we have learned from it and what the public appears to have gained from it.

Before coming to certain details, allow me a few general observations. An already recognized fact has again been corroborated—the interest of the public in living creatures is unflagging. The contrasting elements in the zoological world exert a perpetual fascination. As easy to comprehend Lyra and the distant star galaxies as to accept sans wonder the contrasts found in the innumerable variations in the world of living creatures.

Our smallest exhibit, the radiant, tiny, *Neon* fish from the upper Amazon, drew its share of popular favor, despite the fact that just around the corner was our largest exhibit, the giant panda, prima donna de luxe, the ineffable "Pandora" herself.

Our exhibition was marked by no prearranged orthodoxy. On the contrary, in one small building was made evident the miracle of a veritable miscellany of forms which the dominating masters, Time and Evolution, had wrought for the survival of life on this earth. Sometimes consciously, more often subconsciously, I believe the two hundred and thirty-odd thousand people who visited our exhibition got the implications of that miracle.

Notwithstanding limitations in space, the arrangement of exhibits provided a certain sequence which would perhaps not be noticed by the casual observer, and expressed at least some of the important aspects of zoology. For example, in sequence:—the meaning of Time, as evidenced by New York's population a million years ago, with the background of the continental shore line and the Hudson gorge as it then was; deep-sea life, marvellously adapted for survival in the ocean abysses; other aquatic forms, including the extraordinary specializations of the electric eel; various land forms and their characteristics, including insects, deadly or harmless, from various parts of the world; the social inclinations of animals, (fawns becoming chummy with tortoises until the tree kangaroo became jealous!); colorization extremes, as evidenced by birds and fishes; finally, one large mammal, one of the rarest in the world and definitely the most captivating.

We should, of course, have liked to have more theme, more sequence in the presentation of our exhibits. How vast, however, is zoology in its innumerable aspects! As Mr. Kaempfert, the science editor of the New York *Times,* remarked to me last Spring: "The whole World's Fair area of twelve hundred acres and all the buildings on it would be needed for a real exposition of zoology"—adding, somewhat wistfully, "and what a World's Fair that would be!"

Our World's Fair experience has proved conclusively that the public not only wants to observe living animals but is thirsty for facts regarding them. People wish to *learn* as well as to *look.* Never before has the Society had a similar opportunity of gauging so accurately this insatiable curiosity of the large majority of individuals for information regarding animal life. Our staff of attendants, young men of good education, were kept eternally busy answering questions; and the diagrams and descriptive matter which we tried to make more illuminating than anything of the kind heretofore done at either the Park or Aquarium aroused a great deal of interest and attention.

We are convinced that the instructional guide service added greatly to the popularity of the exhibit as well as to its educational value. This raises the question of what can be done about increasing such facilities at both the Zoological Park and the Aquarium. An extension of our present instructional guide service at both institutions obviously would require additional personnel for which new funds would have to be made available. The effectiveness of this service would naturally depend upon the intelligence and care with which it was organized. There is no question but that it would contribute materially to our function as an educational institution.

In regard to the other method, namely, accompanying our living exhibits by informative and engaging descriptive matter of the best possible design, our World's Fair experience has taught us several lessons as to the most desirable methods to be used and has given a strong impulse to work which our organization commenced a year or more ago. Already a marked improvement in the design and content of labels at the Zoological Park has taken place. The problem at the Aquarium, due to physical limitations of our present building, is difficult. Whatever can be done there will be done. The plans for a new Aquarium provide splendid opportunities for advanced exhibitional methods. Our World's Fair exhibition was in the nature of a testing and proving ground for a more advanced technique. We now have a better idea of what the public wants and have made a step forward in our knowledge of how to give our five million annual visitors not only recreation but additional information as to the innumerable interesting facts regarding the world of living creatures. Herein lies an area for future development the possibilities of which we can by no means measure.

Another experiment we made—which as a laboratory test proved eminently successful and aroused great popular interest—was what we called "the natural live habitat group." This is a long name for a simple idea. The purpose of this exhibit was to place in the same area a number of individuals of entirely unrelated families as they might, to a certain degree, live in nature: mammals of various kinds, reptiles and birds. Ideally we would have grouped various animals from a given continental area, but this did not prove practicable because of the extremely limited space available. So we ended up in a compromise—with tree kangaroos, a wallaby, a wombat, large Galápagos tortoises, two fawns and numerous birds. They made their social readjustments rapidly; astounding, almost scandalous, friendships developed, notably between a fawn, a tortoise and a kangaroo (shades of Aesop!), and no serious animosities arose except in the case of an American magpie, who, as a self-appointed dictator, made the lives of even the kangaroos and tortoises so miserable that he was dispatched back to the Zoological Park in disgrace. The public was particularly delighted with this exhibit. On its surface it appears a trivial experiment, but, as a matter of fact, it may have a major effect on the future development of the Zoological Park. This is along lines which at first might appear radical in concept but if capable of practical adaptation on a large scale would perhaps be the means of developing a new and highly illuminating method of zoological exhibition, viz, the exhibition of living forms in the natural groupings of their continental or geographic derivations rather than by the scientific classification of kinds. It is too early to speculate as to what can be worked out along practical lines in this regard. It may be that the Zoological Park of the future will be a happy combination of the two methods. In any case, the officers and staff of the Society are at present actively working on plans which have in them the potentialities of a new approach to the problem of how to exhibit animals as they would be found in nature, not only as to environment, but also as to social groupings and evolutionary influences.

The health of our collections remained excellent throughout the World's Fair period, the only exception being the Florida otter. This species is highly sensitive to changes in climate and environment. We received a few complaints as to the enclosure in which the giant panda was housed. She has answered these complaints herself, having gained 51 pounds while at the Fair (May 1, 135 pounds; November 1, 186 pounds), ending the season in buoyant health.

Some of the data regarding our attendance is of interest. With an aggregate of more than 238,000 paid admissions it will be noted that approximately one out of every one hundred persons who entered the Fair grounds visited our small building. This is a most gratifying result when one considers the vast size of the Fair and its unprecedented number of exhibits, all competing for public interest, the great majority offering free admission. The fact that the Fair attendance ran materially below even the more conservative pre-Fair estimates, and the difficulties of exhibitors in general, have already been sufficiently publicized. With these general conditions in mind, the Society's exhibit more than maintained its position in the public interest, and drew a steadily increasing proportion of visitors as the Fair progressed.

We have prepared a number of graphs having to do with various aspects of our attendance figures. It would be an infliction to present them here. Perhaps one or two items are of interest, however. For example, the hour of peak attendance occurred between 10:30 and 11:30 in the evening, the second heaviest "traffic" hour occurring between 4:30 and 5:30 in the afternoon. We were interested also in studying the proportional attendance of adults and children, which ran: adults 76.34%, children 23.66%.

As a World's Fair crowd has its own psychology, every building and exhibit developed its special methods of capturing attention, which accounts for the lurid murals on the walls of the Hall of Pharmacy. (I trust they were not designed or intended to be representative of the science of medicine!). So, too, one noticed the "mass" appeal of the Russian building, (I refer to monoliths, not man), montages for the Kodak building, garish neons for the Aquacade, tom-toms for Jungle-land, and so on. In our case we attempted to steer a middle course. The bathysphere, the photographic montages which were installed in June, "Jimmy" the kinkajou in the arms of the announcer, a particularly gay toucan, the descriptive signs—all these caught the public's eye. Word of mouth publicity had a definite effect. "That Zoological exhibit is worth seeing." Our attendants were told frequently by visitors that they had been urged by friends to come. But back of this was the personality of our giant panda Pandora. The public loves a personality, and Pandora has "it." She proved the main drawing card of our exhibit. Further, her precocious antics probably brought more "repeat" visitors than any other single attraction in the entire World of Tomorrow. (Many came to our building more than a dozen times!) With all that, this extraordinary animal did not in actuality steal the show. To put it another way, she was the principal magnet that brought a large proportion of our public into the building, and when she was up to her mischief, which she usually was, she removed from the mind of man all shadows of the man-made troubles we are now living through. But there were so many other things of interest in the building, and—to the eternal satisfaction of all of us intimately connected with the exhibit and constantly observant of the public's reactions—our visitors appreciated them and got uncountable values from them. How, in the last analysis, can we measure these values and at the same time appraise the worthwhileness of this enterprise, thereby justifying the generous financial support accorded by a number of our trustees as well as the time and energy expended by our organization?

To have done our part as one of the great public institutions of this city is one element in the picture. We received our full share of attendance and popular interest, and in so doing gave true recreation and education to a large number of people. We publicized the name of the Society and created a broader understanding of its activities and aims. We made a host of new friends who in one way or another will contribute to the growth of the Society, and our organization is immeasurably benefited by experiences which can be turned directly to account in our future development. Sometimes, too, a sidelight appears which illuminates the answer we are searching for. In a recent issue of the Harvard Alumni *Bulletin* we read:

> "The throngs who have sat all summer in endlessly circling armchairs, the voice of God breathing down their necks as they gazed at General Motors' conception of tomorrow's world, exhibited a proper degree of awe, but, alas, singularly little pleasure. For really happy World's Fair faces one had to look elsewhere—for example, into the little building—cool, quiet, dark—that houses the Giant Panda. The human eye and ear, surfeited and stupefied by the vast, the swift, the streamlined, the "modern," the spin of color and the bray of amplifier, turn to this benign little animal with a grateful sense of relief. In a corridor near the Panda's air-conditioned *lebensraum* stands a small glass case containing a colony of Malayan insects. In the case is a miniature shrub, thick

with green leaves. Till one of them stirs, it is literally impossible to tell which is leaf and which insect. The sense of innate perfection is instantly gratified by the little creatures."

The other sidelight—if this is the proper word for it—is a passage from a sermon delivered in Seattle by Dr. Edgren Tener on the eve of the outbreak of the war in Europe:

"On the day when we are asked to pray for peace to come to a world which seems so hopelessly menaced by some men's ruthless envy of their neighbour and of their betrayal of their own people's destiny, I can think of no more potent instance than the following, which, however, some of you may consider too homely for me to use in connection with a subject so important. During my visits to the New York World's Fair I went as always to see the Giant Panda at the New York Zoological Bathyspherium and the excellent surrounding exhibit. One night one of the attendants was in the enclosure with the animal. She was leaning on him and stroking him with her paws—obviously without any fear or even timidity. The attendant was equally at ease with her. When he came out I said to him "Aren't you afraid of her?" He answered me by smiling. I repeated my question and added "Doesn't she sometimes attack you?" His answer was simply "She has no enemies." When shall we have a world in which man can ask one of another: "Aren't you afraid of him? Doesn't he sometimes attack you?" and to which the answer will be "He has no enemies."

Our visitors from Cambridge and Seattle have a clarity of interpretation that I envy. By comparison my own impressions of the public's reactions seem lacking in distinctness but I shall give them nevertheless. Motivated not so much by any feeling of duty to the enterprise as by a peculiar sense of enjoyment, I used to spend hours on end drifting around the building, observing the reactions of people to the various exhibits, listening in on conversations, studying the expressions on faces of young boys, middle-aged people, lone visitors, family groups, rich people, poor people. The predominant impression I gained was one of a curious concentration mixed with a quality of relaxed enjoyment—a desire to know more of the "why" and "wherefore" of this creature world, a slightly baffled "does it affect me?" look, combined with outright unthinking pleasure at the sight of a radiant tanager, glowing deep-sea fish, or completely captivating panda. 238,000 of such people! We wish we could have given them more!

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NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

Reserve the Date!

Members of the Zoological Society will have a preview of several innovations at the Zoological Park during the forty-sixth annual meeting on Tuesday evening, January 9, at the Waldorf-Astoria. Unfortunately only a few of the plans being worked out this winter for execution next spring are capable of being transported to the Silver Corridor of the hotel, but—fortunately—they will provide an incentive for the members to visit the Park during the spring!

A preliminary announcement setting forth as many details of the meeting program as are definite at present will be mailed to the members in the next few days.

Rescue at Sea

Little incidents of animal history have a tendency to repeat themselves over a long period of years. The story of the duckhawks rescued at sea has a gap of thirty-five years between the first and the latest incidents.

On October 7, 1904, the steamer *El Dorado* reached New York with four duckhawks aboard, and they were presented to the young but rapidly growing New York Zoological Park. Three had flown aboard, hungry and exhausted, while the steamer was crossing the Gulf of Mexico, and the fourth one north of Cape Hatteras.

Since that time an occasional duckhawk has been picked up at sea, and usually its destination was the bird collection at the Zoological Park. Never, however, more than one in a season.

A few days ago Quartermaster S. Szunyoch of the S.S. *Jamaica*, newly arrived in port, phoned Curator Crandall that he would like to present two duckhawks to the zoo. He had had three, but the third one overtaxed his facilities for caring for them aboard ship, and after feeding it and allowing it to rest he turned the bird loose. All three of the birds had flown aboard while the *Jamaica* was off the island of that name.

Duckhawks are comparatively rare birds; indeed, there are so few of them that amateur and professional ornithologists know the location of virtually all if not all of their eyries in the East. Too, they are extremely fast and powerful flyers—the duckhawk holds the official (although debated) speed record of 180 miles an hour.

Why birds that are fairly rare, and are such capable flyers, should happen to be picked up in threes and fours far out at sea is rather puzzling. So, too, is that fact that one of the birds rescued in 1904 was found north of Hatteras, for almost all other records of duckhawks at sea come from considerably further south among the islands of the Caribbean.

The majority of duckhawks from this region migrate to the Caribbean latitudes during the fall, but some of them certainly remain in the North during the winter. Five years ago Curator Crandall first saw a duckhawk circling the tower of the Riverside Baptist Church, and he noticed it off and on all through the winter. Apparently it was finding the ecclesiastical pigeons an easy source of food. A duckhawk has been reported from the neighborhood of the church in subsequent winters, and was still there late this fall. Others have often been reported from the heights of the East River bridges—another district where pigeons abound.

Byrd's Penguins at Aquarium

Almost a score of penguins that were shown during the summer at Admiral Richard E. Byrd's exhibit at the World's Fair were "taken to board" at the Aquarium after the closing of the Fair. The explorer, now engaged in another trip to the Antarctic, expects to sell the birds, but in the meantime they make a most attractive display in one of the Aquarium's big floor pools. At present there are fourteen Humboldt's penguins, and three black-footed penguins.

The guest penguins, as well as the Aquarium's own five specimens of the black-footed species, are fed herrings, smelts and killies three times a day. The newcomers learned a number of tricks during their show days at the Fair and readily perform for their keeper.

A fat young opossum that wandered into the Zoological Park from the wilds of Westchester, probably by way of the Bronx River, was captured on a sidewalk near the Rainey Gate late this fall and is now comfortably on exhibition in the Small Mammal House. Wild opossums or raccoons are still fairly frequent—and always unwelcome—visitors to the Park. In past years several serious losses among birds quartered outside have been attributed to them.

The youngest inmates of the Primate House are two Java macaque babies (*Macaca irus*) born on October 4 and October 14.

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ABOUT NEW YORK

By MEYER BERGER

GROUPS of active, screaming children blocked the sidewalk in front of 95 Avenue B. The broad woman at the door stared at us when we asked about the man who raises eagles. "Higgles?" She seemed puzzled. "Birds," we explained, and her face brightened. "Hopstairs," she said. "In the poolroom is higgles."

At the second landing we opened a battered metal door. A German shepherd dog, big as a yearling, sniffed at our coat. Pool balls clicked through banks of stale tobacco smoke in the dark loft. At the lower end of the room, near windows roughly painted red and green, eighteen or twenty men were grouped around two tables.

Yellow light from two drop lamps, thrown up from the green cloth, etched the men's faces in deep shadow. A collarless chap, broad and chunky, face deeply pitted, came to the door.

"The guy you want is Harry," this man said. He turned and called hoarsely across a partition down the room. "Hey, Harry! There's a man here about them eagles." The pool games stopped. Players and watchers looked up. A dozen or more trailed behind Harry when he emerged from behind the partition.

Harry is a little man. Thin, coarse black hair combed back, but at this moment drooped in disorderly locks on his forehead. His thin hands were jammed in the side-pockets of his black sweater. Like the chunky chap, he was collarless. As he faced us the pool-game kibitzers formed round him in a semi-circle.

Harry seemed uneasy, perhaps out of modesty. He said eagles were his hobby—eagles, hawks and pigeons.

"Kind of an East Side Audubon?" we suggested.

Harry shrugged. His eyes darted to a picture frame on one of the walls. Newspaper clippings in the frame told how Harry Leiner's eagles had escaped into Tompkins Square one day last September and how the lower East Side had been thrown into a hubbub over it. The photographs showed Harry holding one of the birds.

"That's Harry's picture in the papers," one of the customers explained. "He got lots of publicity out of them eagles."

Mr. Leiner squirmed, out of sheer modesty. He has a friend, he said, who is a seaman on a tramp steamer. "Right now this guy is in Africa," he told us. "If he sees any good buys in wild birds he gets them for me. I raise 'em, but only for a hobby."

One of the customers urged him to tell about the hawks the seaman brought home a year ago.

"I don't know for sure," Harry said, "but I think those were chippy hawks. I raised them on raw meat, upstairs, in the empty loft. In seven months they was eating like brewery horses. I gave them to a guy up in Throggs Neck."

The eagles, it seems, came in with the seaman seven months ago. Like the hawks, they were turned loose in the upstairs loft. Like the hawks, they gobbled fresh meat. Their wingspread increased enormously.

Mr. Leiner did not know how they broke out.

"It was spite woik," said one of the customers.

Harry hunched his thin shoulders. However it was, the birds got out. Children, coming from school, filled Avenue B as the eagles flew from tenement roof to tenement roof. Men and women leaned from windows and screamed to the children to get into hallways. Pushcart men ducked for cover. Some one telephoned for the police emergency. The pool hall emptied, and Harry formed hunting squads. He took one group, and Henny Worsena took the other.

Worsena got one of the birds in a yard in Tenth Street, where a woman keeps pigeons.

"A guy had a holt of him," said Mr. Worsena, "and he was clawin' the pants off this guy until I grabbed him."

Harry, the pale Audubon, got the second bird on a fire escape near Christadora House.

"He didn't fight," said Harry, "because he was used to me. He knew I was the guy that was feeding him. They would have come back anyway, only they were excited. They was stiff and in no shape to fly."

He had to give the birds away, though. The neighbors didn't want eagles around. "Brazilian eagles, these was," said Harry, "not American eagles."

He gave one of the birds to the Zoo on Staten Island, one to the New York Zoo. One of the customers said he bet the Zoos were glad to get these Brazilian eagles. "They gave Harry a certificate for the eagles," this customer told us.

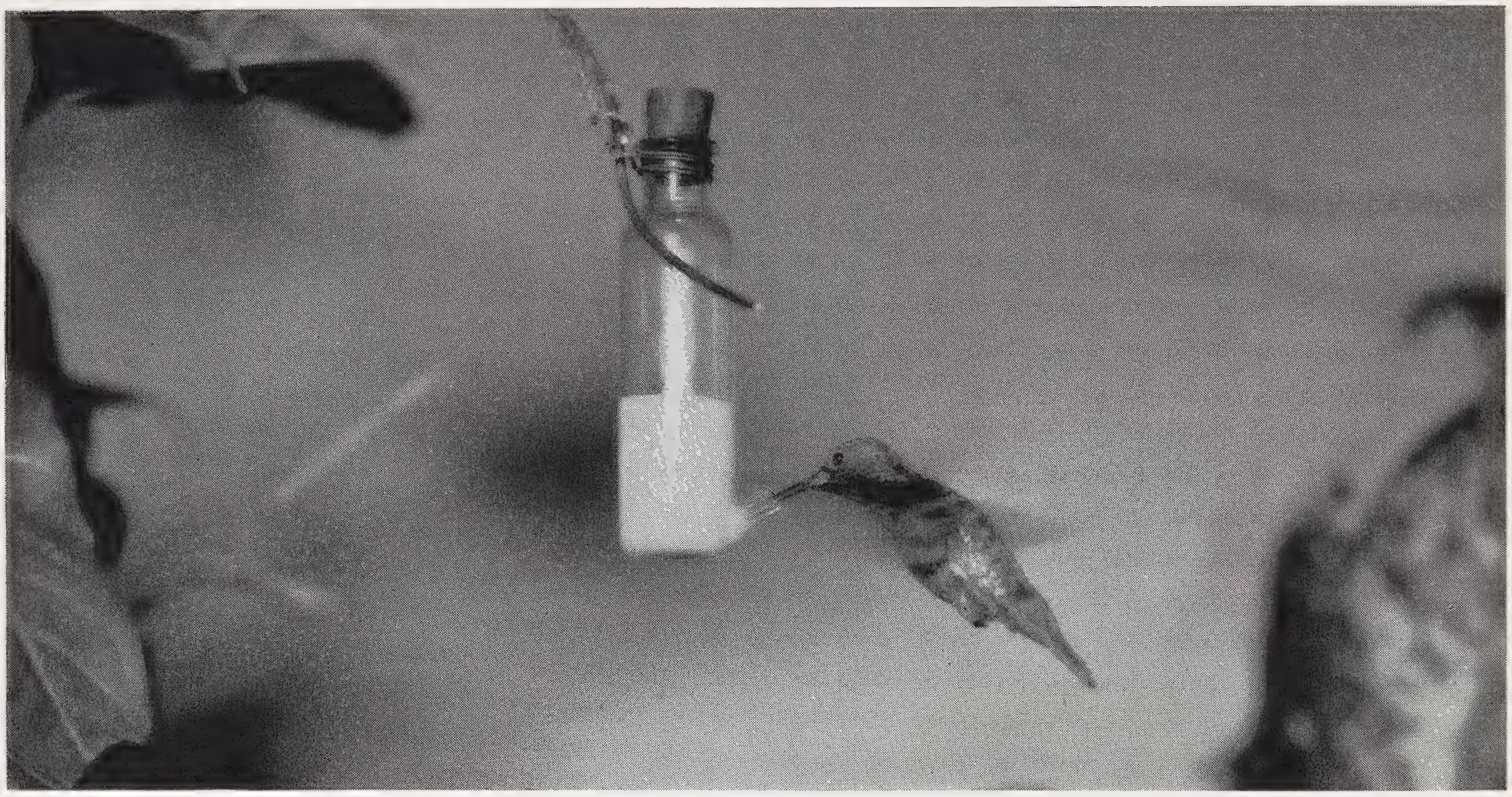
The pool players grew impatient. They could stand so much ornithology and no more.

"Hey, Harry," one said, "why don't you get this guy away from here? He's breaking up the game."

Harry seemed nervous. He delegated one of his helpers to lead us to the roof. We climbed three flights of dark iron stairs with a queue of pool-hall kibitzers behind us.

On the roof the sun was bright. The air was clean and crisp. One of the men pulled a latch-string, and assorted pigeons—Chinese dun owls, Russian high-flyers, two homing birds, some model bronzes and some tumblers—whirred out of the coop. They organized over Avenue B, swung out over Tompkins Square Park, and circled over our heads.

One of the men climbed into the coop and came out with a fresh pigeon's egg. He put it in our hand. "It's good if you drop it in a malted milk," he earnestly assured us, but we gave it back. A



Faster than the human eye can follow—and faster than most cameras—the tiny wings of the Caribbean emerald hummingbird make sixty beats a second as the bird hovers before a bottle of imitation nectar in the new Hummingbird House in the west end of the flying cage.

tall, thin youth with hollow cheeks reached for it, broke the shell against the chicken wire, and drained the contents. This youth, one of the kibitzers whispered, is known on Avenue B as The Scholar.

"He's smart," our informant said. He turned to the thin one. "Give him a debate, Scholar," he urged, but The Scholar was not in the mood. He leaned against the scabrous roof wall, in silence.

We learned about "hit-outs," birds that flop to a near-by roof and refuse to budge; about "clucks" that blunder into aerial wires and other roof obstructions; how the birds follow wind currents, and about the hawks that live in the towers of the Brooklyn, Williamsburg and Manhattan Bridges in Winter and come out to prey on the pigeon flocks.

Overhead, almost out of sight, the flock spiralled in the sun. The birds were visible only now and then in momentary glints of white, as they wheeled in formation. "That's what we call 'pin-high,' or 'in the marble,' " one of the bird fanciers explained. "It means they look small as a pin, or tiny like a marble."

We stayed a while, looking down into the narrow, crowded East Side streets; at the scaly-brick walls and cluttered roofs around us and at Tompkins Square Park, a lone patch of bronze-green in a great area of slums. Skyscrapers were misty at the skyline.

As we passed the pool hall landing one of the customers brought us the "certificate" Harry got for his "eagles." It was on a letterhead of the New York Zoological Society.

"My dear Mr. Leiner," it said. "Please deliver to bearer one South American Turkey Vulture for which this letter will serve as receipt."

It was signed by Lee S. Crandall, curator at the zoo.

Getting Used to Freedom

Two white-tailed deer fawns that were on exhibition in the Society's building at the World's Fair are only now, a month after the closing of the Fair, getting used to the enlarged freedom that is theirs in a big range in the Zoological Park. Among the miscellaneous group of animals in the habitat grotto of the Fair building—Galápagos tortoises, tree kangaroos, birds of various kinds—they were perfectly at home and unafraid. Keepers who entered the grotto to clean it and distribute food were always in danger of having their trousers nibbled by the inquisitive animals.

During the summer more than two hundred thousand persons passed within a few feet of the fawns without alarming them once. But the sudden transition from their artificial habitat to an open range, more nearly approximating their natural habitat, produced an unexpected reaction. The fawns were timid and skittish for the first two or three weeks. Once, when a truck passed within a hundred feet of them, they bounded across the corral and into a fence. On another occasion the sudden emergence of a keeper from a building next door sent them careening away.

They have gradually become more accustomed to the out-of-doors, however, and are settling down into an easy acceptance of man-made noises.

An Argus pheasant chick, hatched in August in the pheasant collection, has now grown to its full size. This is the third Argus chick reared in the Zoological Park, and these three are apparently the only ones ever reared in the East. The young bird, a hen, is almost as large as its mother, but it still trails around with her and keeps in the shelter of her tail.

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